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SCIENTIFIC MANAGEMENT AND THE CIVIL SERVICE

THE recommendations of the Baillieu Report regarding the establishment of a British Institute of Management* bring to mind many criticisms made in recent years of the Civil Service, which, although its many virtues are willingly conceded, is considered to be in some respects unsuited for the tasks now before it. The matter is raised in an admirable article in the last issue of *Agenda*, by Prof. R. S. T. Chorley, who is Sir Ernest Cassel professor of commercial and industrial law in the University of London, and also served as an assistant secretary in the Ministry of Home Security during the War; Prof. Chorley is thus able to look at the Civil Service with both detachment and inside knowledge. Another publication worth re-reading in this connexion is Mr. H. E. Dale's book "The Higher Civil Service of Great Britain", published in 1941.

Prof. Chorley's experience from inside the Civil Service leads him to the opinion, it may be noted, that the average Civil servant is more loyal than the average serving officer in the Armed Forces; and although that loyalty is tempered by discretion, difficulties in securing the rapid implementation of a government policy through the existing machinery of government will be due to inherent weaknesses in that machinery rather than to any lack of loyalty.

First among these weaknesses, Prof. Chorley suggests, is the committee system which, pushed to extremes, has become a menace to efficiency. Next there is a certain lethargy due to lack of interest in the work, particularly in the junior administrative, the clerical and the executive grades. Further, keenness is not a common characteristic of the Civil Service, and this Prof. Chorley is inclined to attribute to excessive drain on vitality imposed by the examination system. The main responsibility for this position rests with the universities, and there are encouraging signs that they are awakening to the position.

The general agreement on absence of drive, initiative, vitality and imagination as a principal weakness of the Civil Service points to the importance of recruiting the right people, seeing that their training is such as not only to maintain but also to enhance initiative and energy, and ensuring conditions of work under which such qualities are given encouragement and scope. In regard to the first, Prof. Chorley criticizes the White Paper on recruitment as conservative and unenterprising. The examination must remain, but it could be made much more a test of ability to think rather than of knowledge, and less weighted in favour of arts subjects. Prof. Chorley considers that those with training in natural science in the Service have a fresher and more business-like approach to their work than the arts graduates. While the interviewing board should recede definitely into the background, the interview should not be abolished, and Prof. Chorley would attempt to establish a panel of experts in interviewing: capable establishment officers would provide the best nucleus when available. He would also experiment with

* See *Nature* of May 11, p. 601.

psychological and intelligence tests, but would place more and more reliance on the candidates' record of past work.

In regard to training, Prof. Chorley insists on the importance of providing some measure of responsibility from the start. Again we must be less squeamish about mistakes. This is a matter both for Ministers and for members of Parliament: the parliamentary question must be used with more sense of proportion and with a fuller appreciation that it is a two-edged weapon and can sabotage the machinery on which the working of democracy depends. On the importance of provincial service and mobility, Prof. Chorley endorses the proposals of the Assheton Report. He insists on the necessity of real training, on more real study of, and research in, administration. The training in general principles of administration should be provided by the universities, aided on the technical side by Civil servants. The method of spending sabbatical leave should bear some definite relation to the man's work.

As to promotion, Prof. Chorley challenges the tradition that it must not come until the late thirties or early forties. Much excellent material in the subordinate grades is being wasted in this way, and more could be done to keep alive the interest and keenness of such officers. But to ensure that by the age of forty vitality is unimpaired and that the Civil servant will show a dynamic approach to the problems confronting him is largely a matter for the politicians. On the deterioration of the Service between the Wars, while Prof. Chorley agrees that, apart from the Liberal administration of 1906–15, the general level of cabinet ministers is now higher, there has been no sending out of young men of thirty to run new and improvised machines, and the character and quality of the administration are inevitably reflected in the outlook and attitude of the Civil Service. Apart from this political aspect, Prof. Chorley comes back to his earlier insistence on the importance of giving greater responsibility to juniors and abandoning the safety-first policy. Finally, he stresses the importance of the establishment officers and of attempting to fit officers into jobs for which they are well suited, on the value of greater interchange—up to 20–30 per cent of positions—and of a constant stream of new blood. Prof. Chorley thinks that there are now more first-class administrators among the permanent secretaries or under-secretaries of State than thirty years ago, but some of the Ministries do not seem ever to have had a first-rate administrative head for any length of time. Out-of-date methods and conditions of work are strongly denounced, and attention is finally directed to the question of government publicity and the problems it presents.

Some of these points were emphasized in a debate on man-power problems in the House of Lords on April 3 on a motion of Lord Balfour, which stressed the necessity of the greatest economy consistent with efficiency in the numbers of central and local government staffs, and also of revising the conditions of certain grades of government service to attract the best material available. Lord Balfour pressed, incidentally, for better conditions and a more certain career in the scientific Civil Service, but his main anxiety was lest we might find too large a proportion of our population in the national and local government service, at least in the non-industrial or non-productive divisions.

Lord Pakenham, in a Government reply, was inclined to challenge the distinction between productive and non-productive work; but he accepted the view that we must economize our man-power to the full, and said that the Government is determined in each year to draw up a man-power budget and to try to indicate how it would wish to see the man-power of the nation distributed. As regards the tendency for the expansion of the social services and the nationalization of certain industries to increase the size of the Civil Service, these should be offset against the elimination of some redundant competitive staff. Lord Balfour had asked for a scrutiny of staff as well as for business secondment in peace- as in war-time, and here Lord Pakenham said great stress is now laid on the work of the establishment departments, and that the Treasury is re-introducing a measure of the scrutiny of the amount of man-power in the Service which was inevitably suspended during the War. As regards rates of pay and conditions generally, the Government is concerned with the way in which the competitive pull of the Civil Service compares with that of other occupations. He believes that the position of scientific workers has improved remarkably, and is more favourable than suggested by Lord Balfour.

Clearly, this debate, like Prof. Chorley's paper, points to fields which the new British Institute of Management may well be expected to explore at an early date, and stresses the importance of the contribution it may have to make to administrative efficiency in every sphere of national life, the wise use of man-power and to industrial as well as social efficiency.

BABYLONIAN MATHEMATICS

Mathematical Cuneiform Texts

Edited by O. Neugebauer and A. Sachs; with a Chapter by A. Goetze. (American Oriental Series, Vol. 29.) Pp. 177+49 plates. (New Haven, Conn.: American Oriental Society and the American Schools of Oriental Research, 1945.)

A COMPREHENSIVE work on Babylonian mathematics in English has long been wanted. Apart from a few isolated articles in periodicals, the only material available hitherto was in German. The texts (mainly from the Yale Babylonian Collection) now published are of sufficiently wide range to give a fair impression of the subject as a whole. Several present entirely new features.

The Babylonian system was sexagesimal and used a place-value notation—probably the source of the Hindu-Arabic. Thus, the number which in our decimal system we write as 3610 would appear as 1,0,10 in the sexagesimal. In the earliest times, no sign for zero occurs, but occasionally the zero is indicated as a blank space. A sexagesimal calculation

may be carried out regardless of place-value, which can be determined at the end, just as we determine the position of the decimal point. One of the most significant features of the Babylonian system was its flexibility, and perhaps this constituted an important element in its development.

Tables were of fundamental importance and very numerous. From one type, giving the relations between the various units, the exact number of smaller units in a larger unit could be quickly obtained. They are set out in the same way as those in a modern omnibus which show a passenger the exact fare payable between any two stages.

Tables of products, reciprocals, squares, square roots, cubes, cube-roots, 'logarithms', areas of rectangles (of specified sides) and circles (of given circumferences) find their modern equivalent in our handbooks for scientific men and engineers. The circumference c of a circle was taken as three times the diameter (cf. 1 Kings vii, 23); the area A being calculated from $A = c^2/12$. The multiplication tables comprise only multiples of those numbers which are reciprocals of simple numbers, for the most part contained in the standard tables of reciprocals. Thus, these tables could be used not only for products ab, but also for general fractions a/c if b is the reciprocal of c.

In a sexagesimal system, the reciprocal of a number n can only be *definitely* expressed if that number contains no prime factor not also contained in the base 60 (that is, n must be of the form $n = 2^p3^q5^r$ when p, q and r are integers or zero). As a general rule reciprocal tables are only concerned with such 'regular' numbers, but a surprising example is a table giving *approximate* values for 'irregular' numbers not in the above category.

One new tablet answers the question to what power must a certain number a be raised to yield a given number. This problem is identical with that of finding the logarithm of a given number to base a. These 'logarithm' tables are the logical supplement to the well-known exponential tables. Both show a knowledge of the basic laws of operating with exponents, and had the compilers taken the further step of selecting a common base and tabulating for constant differences, their tables would have been comparable with our modern logarithms. These tables probably originated in calculations of compound interest, of which examples have survived, where the rates are 20 and 33⅓ per cent!

The Problem Texts (dated *c.* 1700 B.C.) cover a wide range. The geometrical group deals with triangles, trapezoids, prisms and truncated pyramids, sometimes accompanied by dimensioned diagrams. Although the terminology is geometrical, the whole treatment is carried out in the spirit of algebra, and there is a complete absence of the geometrical argument which is such a feature of Greek times.

Practical calculations in building construction and irrigation (for example, of the volume of earth removed in digging or enlarging canals) involve details of man-power, time and wages, and throw light on economic conditions. The angle of slope was measured by the 'offset' per unit vertical drop, and a new feature is a sliding scale for output at different depths. New information appears in some problems dealing with bricks, the dimensions of standard sizes and the methods of counting.

Considerable importance was attached to quadratic equations; and in two texts alone occur no fewer than 424 problems leading to a quadratic, such as the determination of x and y from their product xy and sum $x + y$ or difference $x - y$. The problems are arranged according to a consistent plan requiring the use of a common principle comparable with the modern use of an algebraic formula where special letters are substituted for letters appearing as coefficients.

An entirely new type of text contains lists (with brief explanatory notes) of 'coefficients' useful in solving certain problems. For the first time we can study texts having the characteristics of pages from a general handbook.

Most important of all is a text dealing with Pythagorean triangles (right triangles with sides which are integers). *It is the oldest preserved document in ancient number theory.* The scheme proves knowledge of the rules for finding these numbers, namely, of a theorem like Euclid x, 29, Lemma 1. The discussion as to how these numbers—as well as the remarkable approximation to $\sqrt{2}(= 1{\cdot}41421\ldots)$—were arrived at is of particular interest.

Comparison of mathematics in Babylonia with that in ancient Egypt shows the independence of their development. It is also clear that we have at our disposal to-day but a small fraction of the repertoire of either.

Dr. A. Goetze's chapter on Akkadian dialects assists in provenance and dating problems. A useful bibliography, vocabulary and series of plates accompany the texts and commentaries, which are admirably set out with the methodical care and scholarship characteristic of the work of both authors. The whole forms a valuable contribution to the history of mathematics.

R. W. SLOLEY

ANTHROPOLOGY IN AN INDIAN STATE

The Reddis of the Bison Hills

A Study in Acculturation. By Dr. Christoph von Fürer-Haimendorf, in collaboration with Elizabeth von Fürer-Haimendorf. (The Aboriginal Tribes of Hyderabad, Vol. 2.) Pp. xvii + 373 + 84 plates. (Bombay and London: Macmillan and Co., Ltd., 1945.) 20 rupees; 35*s.* net.

DR. CHRISTOPH VON FÜRER-HAIMENDORF'S volume appears very appropriately, now that far-reaching changes in the administration of India are foreshadowed. For although this is the second volume of a series dealing with the aboriginal tribes of H.E.H. the Nizam of Hyderabad's dominions, the problems considered are shared by a large number of primitive tribes in British India, most of whom are less fortunate than those in Hyderabad in that they have never had their problems examined by a trained anthropologist of the same standing. The whole volume is testimony to sympathy, insight, and a power of careful and resourceful analysis of a high order, as well as to the authors' ability to arouse interest in a humble and even humdrum tribe which has none of the spectacular attributes of those on the Assam frontier, for example, though its problems in a rapidly changing environment are, of course, no less urgent. The plentiful illustrations are typical of the brilliant photography which we have learned to associate with Dr. Fürer.

These Reddi are clearly a primitive survival—less primitive, no doubt, than the food-collecting, non-

cultivating Chenchu who formed the subject of the first volume of the series, for they do actually cultivate; but until recently they have cultivated only with the digging-stick, a stage more primitive than that of the hoe, much more so than that of the plough. In the remote hills the digging-stick is still the prevailing implement, though Reddi villagers with level fields and regular contact with the outer world use plough and oxen.

It is perhaps this contact with the outer world that gives rise to the most important part of the book; but their daily life is fully described in the chapters dealing with the tribal environment and economy, the phases of its life, its society, religion, and ritual. The authors then go on to examine the relations of the tribe with the neighbouring populations: that is to say, both with other more or less primitive tribes sharing its environment on much the same cultural level and also with the more sophisticated traders who have penetrated the Reddi country for their own economic ends and exploited the inhabitants for their individual profit.

The history of this exploitation is much the same as that suffered by any primitive tribe in India in contact with the deliberate policy of the Indian merchant adventurer from the plains, who works to obtain complete control of tribesmen quite unfitted to contend with chicanery and all unarmed against the uses he can make of the laws of usury and debt and the procedure of courts of law. The story has been the same everywhere from the forests of Bombay to the foothills of Assam, from the *ghats* of Travancore to the Himalayan *terai*, and the Central and Provincial Governments of India have done little enough to remedy the scandal. It has been part of the British policy in general—it is the result of an attitude indeed probably inherent in the English character—to substitute everywhere the rule of codified law for personal government or for any customary method of administration not referable to written codes. This principle has many obvious advantages and clearly works admirably for those in whom a respect for the law is ingrained, who have lived with it for generations and of whom it is, as it were, part; and it may work well enough for those who are content to accept it and make the most of it as the best of a bunch of poor alternatives. On the other hand, this rule of law may (and does) prove a deadly weapon in the hands of those who have no inherited respect for the principles behind it, no instinctive regard for its proper working, but are prepared to use and exploit it as a means to their own ends, and that against simple folk who comprehend it not at all. It is in this typically English erection of the law into the position of a ruler that is to be found one of the reasons why the British raj is not more popular than it is in India—British administration has long ceased to be personal. The law has neither body to kick nor soul to save, but it can be made a deadly weapon against those who grew and introduced it, provided always the user of the weapon has no inhibitions about its proper use and provided the courts in which it is used obey all the rules.

This digression, however, bears indirectly only on the book under review. For the Reddi the author, with the same gift of careful and penetrating analysis that he has earlier applied to their social and religious institutions, has diagnosed what was wrong with the existing state of affairs, and can happily report much improvement, partly as a result of action taken by the Hyderabad State on his report, partly as the result of the constructive efforts of an Indian ascetic, resident among the Reddi, who had enough personal influence to organise them co-operatively and stimulate them to combined action. The Hill Reddi have been fortunate in their benefactors, and there are not a few lessons to be learned from Dr. Fürer's book which might be applied with advantage in many parts of British India, and one of them is that it is worth while to put trained anthropologists into the field to study the problems of primitive tribes. Dr. Christoph von Fürer-Haimendorf and his wife have earned our gratitude as well as that of the Reddi they describe, and so too has the enlightened administration of H.E.H. the Nizam's Dominions, which has implemented their recommendations and published their book.

J. H. Hutton

THE FRONTIERS OF RICE CULTIVATION

Pioneer Settlement in the Asiatic Tropics
Studies in Land Utilization and Agricultural Colonization in Southeastern Asia. By Karl J. Pelzer. (American Geographical Society, Special Publication No. 29.) Pp. xviii+290. (New York: American Geographical Society, 1945.) 5 dollars.

FOR many years the American Geographical Society has inquired into the possibilities for colonization and land development within the habitable but relatively empty lands of the world, and a series of monographs of very high distinction has resulted. The present volume not only maintains the standard set by its predecessors: it may also justly be described as one of the most significant contributions to the literature of economic geography which has appeared during a decade or more.

Although in general the entire field of the Far Eastern tropics comes within his scope, the archipelagoes of the Philippines and the Netherlands Indies are the special concern of Dr. Pelzer. They invite particularly interesting comparisons from the points of view of land-use and colonization. In view of this concentration on two regions, however, it may perhaps be suggested that a companion volume within the same field of inquiry, but devoted more particularly to Indo-China and Malaya, would help to restore the geographical balance of the work. The suggestion is inspired not only by the extreme dearth of systematic geographical literature on the continental areas of the Far Eastern tropics, but also by the hope that Dr. Pelzer, whose qualifications for the work are so clearly demonstrated, may be chosen to undertake it.

The urgency of existing plans for a more economic use of land and for a more balanced distribution of population within Malaysia and the Philippines is, no doubt, in part attributable to the immediate necessity to offer to the inhabitants better social and economic opportunities than those which the Japanese, however deceitfully, proposed during their brief occupation. From the political point of view, Dr. Pelzer's survey is, therefore, most timely; yet it avoids the slightest suggestion of propaganda. His objectivity is most apparent in his detailed reference to the agrarian problems of the Philippines, for here impartial detachment is especially difficult for an American observer.

Perhaps the author's most important contribution is his discussion of wide contrasts in population density within the tropical Far East. Although rice cultivation is characteristic of the densely settled areas and alone makes possible the highest densities of all, skill in rice-farming and in irrigation varies greatly according to tradition and experience. The areas relatively empty are characterized by 'shifting' agriculture which, though not necessarily wasteful as has so long been assumed, demands an extensive use of land widely at variance with the experience of those rice-growing peasants of the most congested of the islands who show the greatest economy in the use of soil. The impact of one type of farming economy upon another is inevitably disturbing to the more primitive; and protection of the interests of the 'shifting' agriculturist necessarily concerns a paternal government. There is criticism of too-niggardly apportionment of farm-land to Javanese settlers in the Outer Islands, and a warning is offered lest the overcrowding of Java should be repeated in Sumatra and elsewhere.

The volume is superbly produced and generously equipped with maps and bibliographical references.

WALTER FITZGERALD

TRADITION OR FREEDOM?

A Century for Freedom

A Survey of the French 'Philosophers'. By Dr. Kenneth Urwin. (Thinker's Library, No. 109.) Pp. vi + 116. (London: Watts and Co., Ltd., 1946.) 2s. net.

THE aim of the author in presenting this sketch of eighteenth-century thinkers is "to show how much our freedom of thought derives from their determined onslaught on the restrictions imposed upon human reason by the religious system inaugurated and controlled by orthodox Christianity". The theme centres around the attacks on religion by well-known French writers; for the purpose of the book "we may take as their enemy any form of sectarian Christianity". Whenever the word *philosopher* denotes "the French sense of rationalist, social-minded propagandist", it is printed in italics.

Dr. Urwin is well qualified to make a survey of the French *philosophers*, and the inclusion of extracts from the writings of Voltaire, Diderot, d'Alembert, Rousseau, Montesquieu, d'Holbach and others, indicates the scope of his work. The book opens with a brief account of thought in France prior to the eighteenth century, and the first chapter closes with a statement of traditional views concerning man and the universe, with which the *philosophers* had to contend. The "awakening of reason" is traced from the Jesuit–Jansen controversy, and reference made to the English influences of Bacon, Newton, Locke and Hobbes.

The reaction against tradition and authority was expressed in the scientific outlook of Buffon, who taught that we misuse philosophy when our first aim is to find the 'why' of things; our immediate object should be "to find out the *how* of things, the way in which nature acts. . . . That is why we must collect with care the examples which oppose our pretensions; why we must insist upon those facts capable of destroying a general prejudice which we receive from taste, an error which we adopt from choice . . ." A chapter is devoted to "Fact and Theory": in the words of Diderot, "That which has never been called in question has not been demonstrated"; or of Voltaire, "I am not free to believe when I have no evidence".

The influence of the sensationalism of Locke is evident in the treatment of morality by the *philosophers*. They accepted as basic that if all our ideas come to us through our senses, it follows that moral ideas also have their source in human experience. Another chapter deals with the unique claim of Christianity. Voltaire is quoted as summarizing the eighteenth century point of view on tolerance: "It is obvious that any individual who persecutes his brother man, because he does not share his opinions, is a monster". Deism and materialism are successively reviewed, and in the last chapter, on "Religion and Politics", attention is directed to the undesirable control of State by Church. For example, after the Revocation of the Edict of Nantes in 1685, with the consequent persecution of Protestants, a grateful Church granted Louis XIV four times as much money as it usually did. In conclusion, Dr. Urwin summarizes the main work done by the *philosophers*: "Briefly it may be described as giving to man the means of developing himself in his own way, subject only to the duties required of a good citizen".

The value of the book lies in its record of the contribution made by French writers toward that freedom of expression and honesty of thought which are such essential parts of scientific method. A feature which will especially appeal to the general reader is the explanation, as they occur, of such philosophical terms as sensationalism, dualism, etc. There is no index, but useful biographical notes on some of the *philosophers* are inserted at the end of the book.

H. D. ANTHONY

A GREAT INDUSTRIAL SCIENTIST

Willis Rodney Whitney, Pioneer of Industrial Research

By John T. Broderick. Pp. 324+7 plates. (Albany, N.Y.: Fort Orange Press, Inc., 1945.) n.p.

IN a foreword to this volume, Dr. Karl T. Compton writes: "Few scientists have so impressed their ideals upon their contemporaries and followers as has Willis R. Whitney. He has largely set the pattern and philosophy of the modern industrial research laboratories, one of the unique achievements of this century. He was the right man in the right place at the right time."

In 1900, Whitney, who had graduated at the Massachusetts Institute of Technology and the University of Leipzig, was offered by E. W. Rice, then vice-president and technical director of the General Electric Company, U.S.A., a new kind of job for which there was little precedent—that he should undertake the formation of a research laboratory for investigations in the electrical field. A number of American industries already maintained laboratories, but their activities were associated with development or 'trouble shooting', but Rice had something different in mind. He and his associates, including Elihu Thomson, Steinmetz and others, realized that the electrical industry was based on the fundamental researches of Faraday, and that if it was to continue its development and rapid

and healthy growth, it must be fed by a continuing supply of new scientific facts. The choice of Whitney was propitious. During the thirty-two years in which he was director, he built up a research organisation which has earned world-wide fame and has become the Mecca to which large numbers of university graduates have turned their eyes and hopes. As a research director he was unsurpassed; he was able to draw to himself men of the highest scientific calibre and he allowed them the widest latitude. His boundless enthusiasm was contagious and inspiring to all his staff. His recognition of individual achievement was immediate and unreserved. His leadership was of an unusually broad gauge and generous type.

Though trained as a chemist, Whitney's interest penetrated every branch of natural science, and he was able to adapt himself to the practical application of other physical sciences. In the electrical field his versatility found vast scope. His clarity of vision, his gift of concise exposition, his innate friendliness, his faith in men and science were all qualities that contributed towards the making of a great research leader.

In the early days when his research staff was small, Whitney was able to conduct individual research; and it was his experiments which led to the invention of the metallized carbon filament, the first big advance in incandescent lamp efficiency beyond the point reached by Edison. Soon, however, as his staff grew, the demands on his time as director restricted his own research achievements, so that the names associated with the fruits of the research conducted under his direction are those of his associates: that of Langmuir with the gas-filled lamp and other notable achievements, which earned for him the Nobel Prize; that of Coolidge with the development of ductile tungsten and the X-ray tube that bears his name; that of Hull with the thyratron—to mention only a few. One outstanding individual achievement must, however, be mentioned—that associated with fever therapy, which in 1937 brought the award of Chevalier of the Legion of Honour.

Although teaching ceased to be a vocation with Whitney forty-five years ago when he left the Massachusetts Institute of Technology and turned to industrial research, it has always been blended with his work.

The author of the present volume considered that a conventional biography would not be in keeping with Whitney's character. He therefore uses, with interesting and enjoyable effect, a dual form of narration. Linked to, and supplementing, the biographical details there is a record of conversations and typical Whitney writings, so that much of the book is autobiographical in character. In the conversations and writings he tells something of his life and activities—sometimes with typically Whitney humour, sometimes with deep seriousness but generally with an instructive and inspiring message. Composed of sheer delight is the suggested reply to the New York school-girl's request, "Kindly send me some booklets and a little sample of electricity if you can spare it".

As is reflected in the honours and awards bestowed upon him, Whitney's scientific and industrial achievements have been widely recognized, and while the present volume reveals many of the human traits, it is perhaps only those of us who have been privileged to know him personally over a long period who can assess his greatness.

A. P. M. Fleming

ECONOMY IN SAMPLING

Sequential Analysis of Statistical Data

Applications. Prepared by the Statistical Research Group, Columbia University, for the Applied Mathematics Panel, National Defense Research Committee, Office of Scientific Research and Development. (SRG Report 255.) Pp. xxix + 287. (New York: Columbia University Press; London: Oxford University Press, 1945.) 42*s*. net.

THE object of sequential sampling is to reduce the size of the sample which must be drawn to reach a decision about a population within specified limits of error. The classical sampling method is to draw a sample of predetermined size and to examine each member after the complete sample has been obtained. The sequential method performs the operation, so to speak, in reverse by choosing the sample one by one until a point is reached at which the decision can be taken within predetermined limits of error. The sample size is thus not an assigned number but varies from one sample to another, according to the way in which the observations run.

The saving in sample-size imported by the sequential technique varies according to the specified limits of permissible error; but it is nearly always substantial, is often in the neighbourhood of 50 per cent and sometimes may be considerably greater. The method was developed mainly in the United States and Great Britain during the War in connexion with the inspection of mass-produced munitions. It is now off the secret list, and the volume under notice assembles within one cover revised versions of seven reports on the subject prepared by the Statistical Research Group at Columbia University for the Applied Mathematics Panel of the National Defense Research Committee.

After an introductory section, the second report deals with sequential tests for the simple case wherein each member of the sample, after inspection, is assigned to one of two classes, good and bad; such a case arises, for example, where a component has to pass through a gauge to be acceptable. Methods are given for computing or constructing graphically the necessary inspection chart, the operating characteristic (*OC*) curve of the sequential process, the average sample number (*ASN*) curve and the average outgoing quality (*AOQ*) curve. Tables are provided for practical work. Succeeding sections extend the method, first to the case of a double dichotomy and then to the case where the quality under consideration is continuous, for example, the mean and the variance.

An appendix to the last section of this volume gives a brief account of the derivation of the fundamental formulæ, but does not attempt to cover the theoretical side, which has been dealt with elsewhere by Wald, Barnard and others.

These reports are in the main for the practical man. As such they are very good. The exposition is clear, there is an abundance of well-chosen examples and diagrams, and the whole work bears evidence of having been through a process of examination and criticism by men who were actually carrying out the methods in practice. One could have wished for a lower price, seeing that the reports are duplicated copies of typescript, and for larger type in some of the tables, but the text is not difficult to read. The publication of this work will be welcomed by statisticians and engineers.

M. G. Kendall

NUTRIENTS IN BRITISH-GROWN AND IMPORTED WHEAT

SOME GENERAL CONSIDERATIONS

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BRITISH-GROWN wheat, though very suitable for biscuit and some confectionery flours, is relatively poor in baking quality and generally unsuitable for the milling of bread-making flour, except when blended with at least an equal amount of 'strong' imported wheat, of which Canadian Spring ('Manitoba') wheat is the unexcelled example. It is also true that British-grown grain is not so rich in certain nutrients as, for example, Manitoba wheat. Thus Table 1 shows the average protein content in recent years of English wheat and of Manitoba, South American (Plate) and Australian wheats at dispatch or on arrival in Britain.

TABLE 1. PERCENTAGE PROTEIN (N × 5·7) EXPRESSED ON 15 PER CENT MOISTURE BASIS.

Year	1933	1934	1940	1941	1942	1943	1944	1945*
No. 1 Manitoba	14·0	13·95	13·75	13·85	13·85	13·75	13·55	13·15
No. 2 ,,	12·5	12·3	13·85	13·85	13·95	13·65	12·9	12·8
Plate	11·6	11·8	12·5	11·5	11·1	11·8	11·3	11·1
Australian	9·3	9·4	9·8	9·6	10·2	9·6	—	—
English	9·3	10·9	9·6	9·6	9·25	9·0	9·0	9·5

* First ten months.

Comparison of the protein contents of wheats is complicated by the variation which occurs, not only between individual varieties, but also with the same variety from year to year. In the case of Manitoba wheat, this variation has been recorded over a long period in the publications of the Board of Grain Commissioners, and we are indebted to Dr. J. A. Anderson, chief chemist of the Board, for giving us the weighted mean figures shown in Table 1. Incidentally, examination of Manitoba 1 and 2 on arrival in Britain gives figures in close agreement. The average figures for the other wheats are based largely on the extensive analyses carried out in Great Britain by Dr. D. W. Kent-Jones, of the Dover Laboratories, who very kindly made the results available to us. Average figures, of course, oversimplify the problem. Thus in 1944, Dr. Kent-Jones analysed 375 samples of English wheat and found a range of 6·6–13·6 per cent protein content with an average of 9·0 per cent.

A recent detailed comparison of the content of nutrients in Manitoba and English wheats has been made by McCance, Widdowson, Moran, Pringle and Macrae[1]. The Manitoba represented imports of Nos. 1 and 2 grades in June–August 1943, while the English sample was compounded from thirty-two samples covering nineteen varieties grown in different parts of England in 1943. Table 2 shows the analytical figures obtained on these two wheats when expressed on a 15 per cent moisture basis.

TABLE 2. AVERAGE COMPOSITION OF ENGLISH AND CANADIAN WHEAT.

	Manitoba (imported in 1943)	English (1943 crop)
Protein (N × 5·7), per cent	13·62	8·89
Fat, by hydrolysis, per cent	2·49	2·23
Carbohydrate, as starch, per cent	63·0	66·8
Calories, per 100 gm.	328	323
Purine N, mgm./100 gm.	55	31
Fibre, per cent	2·15	2·08
B_1, I.U./gm.	1·18	0·96
Riboflavin, μgm./gm.	1·7	1·7
Nicotinic acid, μgm./gm.	55·0	48·0
Ash, per cent	1·53	1·52
K, per cent	0·312	0·361
Mg, per cent	0·141	0·106
Ca, per cent	0·0276	0·0355
Fe, mgm./100 gm.	3·81	3·05
Zn, mgm./100 gm.	3·73	3·16
Na, mgm./100 gm.	3·20	3·40
Cu, mgm./100 gm.	0·60	0·65
Total P, per cent	0·350	0·340
Phytate P, per cent	0·242	0·233
Cl, per cent	0·0385	0·0355

Many of the figures, including those for ash and its major constituents, show little difference between the wheats. Noteworthy differences, however, apart from protein, are shown in respect of purine nitrogen (the proportionate difference in which is greater than that in the protein), calcium and magnesium, iron and zinc, vitamin B_1 and, to a smaller extent, nicotinic acid.

It has previously been noted that English wheat contains more calcium than Manitoba[2]. It is possible that this is a general characteristic of winter wheat (most English wheat is winter wheat) as opposed to spring wheat, since Plate wheat (South American winter wheat) is almost as rich in calcium as English wheat.

Manitoba wheat is appreciably richer in iron than English. This conclusion is supported by the following additional figures obtained in these laboratories in 1943 and 1944 on two different lots of English and Manitoba wheat (mixed Nos. 1 and 2 grades) respectively.

	Manitoba	English
	(mgm. Fe per 100 gm.)	
1st lot (1943)	3·94	2·95
2nd ,, (1944)	3·77	2·80

Seasonal Differences in Nutrients

Table 1 shows the gross seasonal differences in protein content. The only other factor on which we have any information—and even this is scanty—is vitamin B_1.

Values for the average vitamin B_1 content of the Canadian spring wheat crop are contained in the data of Johannson and Rich[3] for the 1940 crop, of Hoffer, Alcock and Geddes[4] for the 1941 crop, while Dr. J. A. Anderson (private communication) has supplied the figures for the 1942, 1943, 1944 and 1945 crops as determined in the laboratories of the Board of Grain Commissioners.

TABLE 3. VITAMIN B_1 IN MANITOBA WHEAT.

Crop of	Mean B_1, I.U./gm.	Average protein content of entire crop (Bd. of Grain Comm. Rpt.), per cent (expressed on 13·5 per cent moisture basis)
1940	1·31	14·1
1941	1·52	15·1 (the highest on record)
1942	1·17	12·8
1943	1·27	13·5
1944	1·11	13·0
1945	1·36	14·2

The large variation from year to year is striking and has been the subject of much comment in Canada. It is not surprising that various workers (Hoffer, Alcock and Geddes[4]; Whiteside and Jackson[5]; Connor and Straub[6]) found a positive correlation between vitamin B_1 content and protein content of grain. No correlation, however, was found in individual samples studied by Nordgren and Andrews[7], O'Donnell and Bayfield[8] or Johannson and Rich[3], though the last-mentioned four workers conceded that growing conditions which favoured high protein might also produce high vitamin B_1 content.

It has been the general view that English wheats have, as a whole, a considerably lower vitamin B_1

content than Manitoba. On inquiring into the point more closely, it seems that this view has arisen from the examination of samples in 1942, 1943 and 1944, and that as a general statement it may not be correct, since the average vitamin B_1 content of British-grown wheat appears to vary from year to year in a manner similar to that for Manitoba wheat. Unfortunately, there is comparatively little information available on the English wheat of successive harvests until the current year (1945), but some idea of the trend may be judged from the results for a number of samples which have been examined from time to time in these laboratories (Table 4).

TABLE 4. VITAMIN B_1 IN ENGLISH WHEAT.

Crop of	No. of samples	Average B_1 I.U./gm.	Approximate average protein content of crop
1939	20	1·39	9·6
1942	20	1·05	9·0
1943	32	0·96	9·0
1944	12	1·15	9·5
1945	35	1·36	10·3

The data for the 1945 crop were obtained with the help of Mr. Sebert Humphries, of Coxes Lock Milling Co., Weybridge, on thirty-five representative deliveries of British-grown wheat of the 1945 crop, drawn from seven counties of southern England, to a country mill in Surrey. Twenty-one of these samples were of red wheat varieties, including Red Standard or Squarehead's Master (8 samples), Atle (2), Vilmorin strains (2), Yeoman (2), Als (1), Little Joss (1), Webbs Iron Red (1). Fourteen were white, including Holdfast (6), White Victor (5), Steadfast (1) and Million III (1). The vitamin B_1 contents (expressed on a 15 per cent moisture content basis) ranged from 1·06 to 1·62, the mean value being 1·36 I.U./gm. which, it will be seen (Table 3) exceeds that of Manitoba wheat in certain seasons. The protein contents ranged from 7·95 to 13·0, the mean being 10·3 per cent. The samples with vitamin B_1 1·5 or more mostly had high protein content and had been grown with good cultivation; but for the series as a whole there was no significant correlation between protein content and vitamin B_1. It does appear from Table 4, however, that there is a correlation between the *average* vitamin B_1 and the *average* protein content of the English crop from one year to another; thus, when the average vitamin B_1 content has been high, the average protein content appears to have been relatively high, and vice versa. The data for seasonal variation in vitamin B_1 content are too meagre to hazard any explanation; but it is tempting to speculate on the unusual dryness and early ripening of the crops of the 1945 season. The work of O'Donnell and Bayfield[3] suggested that the longer the filling and ripening period, the lower the vitamin B_1 content.

TABLE 5. HERTFORDSHIRE WINTER WHEAT TRIALS, 1945 CROP.

Figures for percentage protein content (N × 5·7) of grain (calculated to 15 per cent moisture content) are given in brackets immediately after the corresponding figures for vitamin B_1 (I.U./gm.)

Centre	Oaklands, St. Albans		Royston		Willian, near Letchworth	
Nature of soil	Loam with flints on loam with flints		Chalky loam on chalky loam		Chalky loam with flints on chalky loam with flints	
Previous crop. Type: Manuring:	Barley 1 cwt. s. am., 1½ cwt. super broadcast		Winter wheat None		Potatoes Dung plus 8 cwt. complete	
Manuring of present wheat crop	½ cwt. s. am., 1½ cwt. super broadcast	Also top dressing in late May 2 cwt. nitro-chalk	Dung plus 3 cwt. super	Also top dressing in late May, 2 cwt. nitro-chalk	2 cwt. N.P.K. drilled	Also top dressing in late May
Wheat variety	Vitamin B_1 and protein contents:					
Desprez 80 (Jorequois)	1·24 (7·7)	1·26 (8·4)	1·19 (9·6)	1·27 (10·3)	1·22 (9·0)	1·25 (10·3)
Steadfast	1·20 (7·8)	1·12 (8·2)	1·13 (8·7)	1·11 (9·5)	1·15 (10·3)	1·32 (10·5)
Squareheads Master	1·21 (8·2)	1·07 (8·6)	1·04 (9·9)	1·19 (10·6)	1·14 (10·9)	1·16 (11·7)
Holdfast	1·19 (9·0)	1·28 (9·9)	1·15 (10·2)	1·15 (10·7)	1·16 (10·4)	1·23 (12·1)
Little Joss	1·20 (8·7)	1·19 (8·9)	1·12 (10·0)	1·19 (10·5)	1·11 (10·3)	1·24 (10·4)
Jubilegem	1·09 (7·5)	1·20 (8·6)	1·18 (9·8)	1·24 (10·6)	1·05 (8·9)	1·19 (10·7)
Scandia	1·11 (7·9)	1·22 (8·7)	1·17 (9·8)	1·16 (10·0)		
Juliana	1·18 (8·4)	1·18 (8·8)	1·15 (9·4)	1·17 (9·7)	1·10 (9·5)	1·26 (10·2)
Vilmorin 27	1·24 (8·8)	1·32 (9·7)	1·23 (9·4)	1·25 (10·6)	1·19 (9·6)	1·31 (10·6)
Weibull's Standard	1·06 (7·7)	1·14 (8·2)	1·11 (9·5)	1·17 (10·1)	1·18 (9·6)	1·18 (10·1)
Means	1·17 (8·2)	1·20 (8·8)	1·15 (9·6)	1·19 (10·3)	1·14 (9·8)	1·24 (10·7)

Centre	Harpenden Common	Chorley Wood	Kingswood, nr. Baldock	Much Hadham	
Nature of soil	Loam with flints on clay with flints	Loam with gravel on loam with gravel	Heavy loam with flints on clay with flints	Heavy loam with flints on clay with flints	
Previous crop. Type: Manuring:	Potatoes Complete	Potatoes 5 cwt. No. 2 I.C.I. Special complete	Clover (summer fallow) None	Beans Dung plus 4 cwt. super	
Manuring of present wheat crop	1 cwt. super drilled	1 cwt. No. 2 I.C.I. Special complete drilled	None	2 cwt. Fisons No. 3 drilled	
Wheat variety	Vitamin B_1 and protein contents:				Means of all stations
Desprez 80 (Jorequois)	1·40 (10·3)	1·24 (8·1)	1·37 (10·2)	1·27 (8·9)	1·27 (9·3)
Steadfast	1·40 (10·4)	1·21 (8·2)	1·35 (10·9)	1·27 (8·6)	1·23 (9·3)
Squareheads Master	1·30 (10·8)	1·26 (8·8)	1·35 (11·1)	1·24 (9·7)	1·20 (10·0)
Holdfast	1·32 (12·3)	1·24 (8·5)	1·44 (12·1)	1·30 (10·0)	1·25 (10·5)
Little Joss	1·23 (10·3)	1·23 (9·1)	1·31 (11·2)	1·26 (9·4)	1·21 (9·9)
Jubilegem	1·33 (10·4)	1·29 (7·7)	1·25 (10·1)	1·14 (8·8)	1·20 (9·3)
Scandia	1·39 (10·2)	1·40 (8·2)	1·40 (10·3)	1·14 (8·9)	1·25 (9·2)
Juliana	1·26 (9·6)	1·26 (8·2)	1·35 (9·9)	1·20 (8·8)	1·21 (9·3)
Vilmorin 27	1·42 (11·7)	1·30 (8·7)	1·38 (11·0)	1·32 (10·1)	1·30 (10·0)
Weibull's Standard	1·30 (9·6)	1·18 (8·0)	1·28 (10·3)	1·18 (8·3)	1·18 (9·1)
Means	1·34 (10·6)	1·26 (8·3)	1·35 (10·7)	1·23 (9·1)	Overall averages 1·23 (9·6)

Varietal and Soil Factors

Apart from seasonal variations, there is little so far to relate with vitamin B_1 content. In the series of thirty-five samples referred to, there appeared to be no relationship between vitamin B_1 content on one hand, and colour of grain, variety (in respect of Squarehead's Master, Holdfast and White Victor, of which alone there were sufficient instances to judge), physical character or texture of grain on the other hand. Further, the samples covered a wide range of soil and cultivation, from one grown on chalk downs under 'starvation' conditions to one grown by a market gardener on richly cultivated loam. No definite connexion, however, could be traced between vitamin B_1 content and conditions of cultivation. In this connexion it is worth citing results recently obtained with the help of Mr. H. W. Gardner on a series of samples of individual wheat varieties grown in 1945 at several different centres in Hertfordshire by the War Agricultural Executive Committee for that county. Vitamin B_1 and protein determinations were made on the various samples as shown in Table 5.

Table 5 shows clearly how locality and soil conditions can affect protein content, the range in Holdfast, for example, being 8·5–12·3 per cent. By contrast, the vitamin B_1 content is only slightly affected. Thus, although the vitamin B_1 contents of the grain from several of the centres were very similar, in those localities (Harpenden Common and Kingswood) where the protein content, without late spring top-dressing, averaged more than 10 per cent, the vitamin B_1 content for all varieties averaged 0·1 I.U./gm. higher than the overall mean.

The effect of the nitrogenous top-dressing on vitamin B_1 content of the grain is almost negligible except at Willian, where the average increase was 0·1 I.U./gm., and where the vitamin B_1 content without the top-dressing was relatively low despite a fairly high protein content. It is possibly noteworthy that at Willian the top-dressing caused the greatest increase in protein content of the grain.

TABLE 6. HERTFORDSHIRE SPRING WHEAT TRIALS, 1945 CROP

Figures for percentage protein content (N × 5·7) of grain (calculated to 15 per cent moisture content) are given in brackets immediately after the corresponding figures for vitamin B_1 (I.U./gm.).

Centre	Oaklands, St. Albans		Dane End	
Nature of soil	Gravelly loam on gravel		Loam with flints and pebbles on ditto and clay	
Previous crop : Type : Manuring :	1 year ley, Brussels sprouts 1 cwt. s. am. 2 tons ground chalk		Wheat 1 cwt. s. am.	
Manuring of present wheat crop	1½ cwt. super, ½ cwt. s. am. broadcast. Wheat undersown with lucerne, cocksfoot and timothy		3 cwt. guano cpd.	
Wheat variety	Vitamin B_1 and protein contents			Means
	Plot 1	Plot 2		
Red Marvel	1·20 (9·5)	1·27 (9·1)	1·21 (9·3)	1·26 (9·3)
Fylgia	1·32 (10·8)	1·39 (10·7)	1·31 (12·7)	1·34 (11·4)
Atle	1·32 (9·7)	1·33 (9·9)	1·25 (10·1)	1·30 (9·9)
Kolben II	1·23 (9·7)	1·27 (10·8)	1·19 (10·9)	1·23 (10·2)
April Bearded	1·40 (12·7)	1·38 (11·4)	1·31 (12·7)	1·36 (12·3)
Bersee	1·43 (9·7)	1·37 (9·7)	1·34 (9·6)	1·38 (9·7)
Means	1·37 (10·4)	1·34 (10·1)	1·27 (10·6)	1·32 (10·4)

There is little or no consistent difference in vitamin B_1 content between the different winter varieties examined (despite considerable differences in protein content and in baking quality). If regard is had also to a few comparisons in previous years, the only exception to the apparent rule that one winter variety is as good as another in vitamin B_1 content might be Vilmorin 27, though even here the superiority is slight. It does, however, appear (and it had previously been suspected) that English-grown spring wheats (Table 6) are higher in vitamin B_1 content than the winter wheats, though a clear-cut comparison is not possible from the present data because of soil differences.

Nutrients in Long-Extraction Flours

The nutrient content of the wheat must influence the level of nutrients in 80 per cent or other long-extraction flour. The Report of the Conference on the Post-War Loaf[9] stated that 80 per cent extraction flour can supply the following minima :

	Per 100 gm. of flour
Vitamin B_1	0·24 mgm.
Nicotinic acid	1·60 ,,
Iron	1·65 ,,

In the case of vitamin B_1, it is obvious that a level of 0·24 mgm. per 100 gm. of flour (0·80 I.U./gm.) should be more easily reached in the milling of a wheat containing (say) 1·3 I.U./gm. than in one containing only 1·0 I.U./gm., particularly as the vitamin B_1 is located mainly in the scutellum fraction of the germ, the inclusion of which is the first essential in the milling of the flour. Nicotinic acid and iron, on the other hand, are located mainly in the bran and attached outer endosperm, so it is not so obvious how far a high content of these two nutrients in the wheat influences the content in the flour. Further milling research is wanted on this point. Incidentally, even with two 80 per cent flours of similar colour from two wheats of the same vitamin B_1 content, one flour may have a higher B_1 content than the other because the vitamin B-rich scutellum may enter the flour more easily during a given milling process. Hoffer, Alcock and Geddes[4] discuss this question, and Alcock (private communication) has since informed us that general experience is that mills in Alberta produce a 'Vitamin B White Flour' (about 78 per cent extraction) which is usually lower in ash and better in colour and higher in vitamin B_1 or both (in other words, which has a better 'vitamin B_1-ash ratio') than mills in the eastern prairies, even though the evidence as a whole is that there is no significant difference between the vitamin B_1 contents of the wheats from these two regions.

Quality of British-grown Wheat

Apart from nutrient content and the well-recognized factors of yield, freedom from disease and bread-making quality, there is also the question of dormancy. Greer and Hutchinson[10] have found that wheat when freshly harvested exhibits dormancy in varying degree ; that is, some varieties, given suitable conditions, will germinate more readily than others. This is an important factor, since germination at harvesting to any significant extent increases the content of enzymes, particularly of α-amylase, which ruins wheat for bread-making. This happened to a serious extent in the 1944 harvest.

If in Britain we continue to grow wheat on an extensive scale for bread-making, and if in addition

bread-making flour has to conform to certain standards of nutrients derived from the wheat grain, it is clear that attention will have to be given to the selection and/or breeding and cultivation of the most desirable varieties of wheat. The problem is a wide field of investigation calling for careful planning, co-operative research and the proper co-ordination of the results. The first requirement would appear to be an intensive survey of the nutrient levels of known varieties grown under experimental conditions, coupled with milling and baking tests to assess the quality of the flours (nutritional and bread-making) milled from the wheats.

[1] McCance, R. A., Widdowson, E. M., Moran, T., Pringle, W. J. S., and Macrae, T. F., *Biochem. J.*, **30**, 13 (1945).

[2] Booth, R. G., Carter, R. H., Jones, C. R., and Moran, T., *Chem. and Ind.*, **60**, 903 (1941). Fuller paper published in Annual Report (1944) of Food Group of Society of Chemical Industry.

[3] Johannson, H., and Rich, C. E., *Cer. Chem.*, **19**, 308 (1942).

[4] Hoffer, A., Alcock, A. W., and Geddes, W. F., *Cer. Chem.*, **21**, 210 (1944).

[5] Whiteside, A. G. O., and Jackson, S. H., *Cer. Chem.*, **20**, 542 (1943).

[6] Connor and Straub, *Cer. Chem.*, **18**, 671 (1941).

[7] Nordgren, R., and Andrews, J. S., *Cer. Chem.*, **18**, 802 (1941).

[8] O'Donnell, W. W., and Bayfield, E. G., Paper presented at annual meeting of Amer. Assoc. Cer. Chemists, May 1943 (cited by Hoffer, Alcock and Geddes, ref. 4).

[9] Report of the Conference on the Post-War Loaf. Cmd. 6701. (London: H.M. Stationery Office, 1945.)

[10] Greer, E. N., and Hutchinson, J. B., *Nature*, **155**, 381 (1945).

DEGAUSSING

FOLLOWING closely on the recent conference on radar held at the Institution of Electrical Engineers, another well-guarded war-time secret was discussed in a symposium of papers on degaussing, held at the Institution during April 4 and 5. Naval uniforms were well in evidence among the several hundred who assembled on the first night to hear the symposium introduced by the Third Sea Lord, Vice-Admiral C. S. Daniel. The First Sea Lord, Viscount Cunningham of Hyndhope, who had agreed to make the introductory speech, was unfortunately unable to be present. Admiral Daniel directed attention to the immensity of the task involved in the application of degaussing to hundreds of warships and thousands of merchant ships in the first few months of the War, but stressed also the importance of the preliminary work which had been done in the period between the two Wars. Degaussing was an example of the frequently observed fact that problems which were matters only of academic interest to one generation might become of vital practical importance to the next. As further evidence that we were not behind the Germans, he mentioned that both magnetic and acoustic mines had been used by the British in the War of 1914–18.

The symposium then opened with a paper given by Mr. H. W. K. Kelly with the title "Historical Introduction to Degaussing covering Pre-war Work and Development up to the Start of the Campaign against the German Magnetic Mine". Mr. Kelly started from the War of 1914–18, when magnetic weapons were first used. By 1936, knowledge of ships' magnetic fields had so far advanced that the Admiralty was able to set up a committee, known as the Anti-Non-Contact (A.N.C.) Committee, to investigate the problem of how to alter the magnetic state of a ship so as to protect it from detection or destruction by magnetic means. It was at this time that 'degaussing' was born, although it was not given this title until its war-time application in 1939. As it happened, although degaussing was considered in 1936, it was deemed impracticable and was not pursued. It was only when the German magnetic mine had been examined, and shown to be a relatively coarse unit, operating only on changes in *vertical* magnetic field, and hence peculiarly easy to counter by partial demagnetization, that the policy of degaussing became worth while.

The second paper described the "Underwater Measurements of Magnetic Field" and was read by Dr. D. H. Parnum. The measurement of the magnetic fields of ships for degaussing purposes is generally carried out on 'open ranges'. These consist of a set of measuring instruments placed on the sea-bed in an open channel along which the ship can sail, preferably in the course of her normal duties. By using a large number of measuring points, a complete set of contours can be obtained simultaneously, and the exact positioning of the ship over any particular instrument —always a difficult task at sea—becomes less important. The basic form of instrument used on these ranges consists of a search coil plus a flux-meter. The search coil lies on the sea-bed and records the changing magnetic flux produced by the ship's passage.

In cases where space or other considerations require the ships to be stationary when measured, the open range or dynamic method is clearly inapplicable. In these circumstances a 'fixed range' or 'keel-hauling' method is used. Each of these methods requires the measurement of total field instead of the ship's field alone. The ship's field has then to be obtained by subtraction of the earth's field at the same position in the absence of the ship. Since these fields are large compared with their difference, there is greater possibility of error in this method.

In the fixed range the measuring instruments are placed on the sea-bed. When keel hauling is used, the instruments are slung over the ship's side in the appropriate position. The magnetometers most widely used for this purpose were the pistol magnetometer, first developed in 1927, and the E.F.S. magnetometer, developed during the First World War.

In the pistol magnetometer compressed air is used to move a mumetal core into and out of a solenoid. The E.F.S. magnetometer, which has now largely superseded the pistol type, is similar but has no moving parts. A mumetal-cored solenoid is used, and in a second winding, known as the impulse winding, a current is passed, momentarily, sufficient to saturate the core. Since the saturated flux will be independent of the initial flux through the core, the change in flux so produced is a measure of the initial field and can be measured on a fluxmeter. In practice a balanced method is used to improve accuracy.

The last paper on the first day was given by Mr. R. J. Gossage on "The Use of Ship Models Magnetically to Scale in Degaussing Research". The use of models to investigate a ship's fields and the effect of energized windings around the ship on them had been started before the War. It was vastly extended during the War, and its importance in providing a ready means of estimating the effects of various degaussing treatments, determining the optimum position of coils, etc., is readily apparent. It is imperative, however, to be sure what is involved in 'magnetic scaling', so that the model results may be satisfactorily applied to the full-scale case. Mr. Gossage showed how the similitudes were correctly fulfilled, and that fields

identical on model- and full-scale could be produced, if all dimensions are scaled proportionately. To avoid the use of the extremely thin plating which this would demand, the product of permeability of material by thickness may be held constant instead, that is, low permeability material of relatively large thickness may be employed. Ampere-turns in coils must be $1/N$ of full-scale values, and for time-dependent effects, the time must be scaled down $1/N^2$.

The paper was illustrated with a number of slides showing models in the course of construction, and indicating the degree of detailed reproduction of internal fillings, machinery, etc., which was involved. Typical contour curves were also shown which demonstrated that results predicted by model experiments for a given class of vessel were well within the range of results actually obtained on different individuals of that class.

The discussion which followed these papers produced personal reminiscences from many people, now in widely different spheres of life, who had, at some period, especially in the early and feverishly active days of 1939–40, been associated with the D.G. organisation. The discussion was opened by Prof. H. S. W. Massey, and among other speakers were Mr. H. D. McLaren, Mr. S. Butterworth, Dr. W. B. Whitney and Captain J. Hext-Lewes, R.N.

The papers on the second day were more especially devoted to the engineering aspect of degaussing. The author of the first paper, Mr. W. C. Potts, was unfortunately ill, and so his paper on "The Magnetic Field of a Ship and its Neutralization by Coil Degaussing" was read by Dr. S. H. Ayliffe. The magnetic field produced by a ship comprises an induced part, which is caused by the earth's field acting on the steel structure of the ship, and a 'permanent' part due to the retentivity of the ship's steel. The induced part is dependent on the ship's position and course. The permanent part is usually acquired by the ship during its construction and depends on the position and orientation of the ship at this time, when the magnetization produced by the earth's field is effectively 'hammered in'. Although it is not strictly permanent, the normal vibration of sailing only removes this magnetization very slowly; hence it remains substantially unchanged during long periods.

It is convenient further to subdivide the ship's magnetism into three orthogonal components with respect to the ship. These are known as vertical, longitudinal and athwartships components respectively. There are, therefore, six components in all, which are commonly referred to in abbreviated form as P.L.M. (permanent longitudinal magnetism), I.V.M. (induced vertical magnetism), etc.

To compensate these fields, in addition to the use of a horizontal coil round the ship (M-coil), coils on the forecastle (F-coil), and quarterdeck (Q-coil), are necessary to compensate the poles at each end of the ship due to its permanent longitudinal magnetism. F and Q coils are also used to compensate the poles due to the induced longitudinal magnetism (I.L.M.). It is clear that in this case it is necessary to alter the current in the coil to correspond with the ship's course, upon which the induced magnetism depends. A further coil system, the A-coil, a vertical coil usually mounted in two symmetrical parts along the port and starboard sides of the ship, may also be fitted to compensate for athwartships magnetism.

The technical difficulties involved in fitting and supplying these various coil systems were described by Mr. Fraser in "The Electrical Engineering Aspects of Degaussing" by Messrs. I. S. Fraser, A. A. Read, and B. E. Vieyra. The first system tried was a single-turn copper strip, up to 6 in. wide and ¾ in. thick, which was bedded in a rubber channel and fixed around the outside of the ship. Low-voltage generators of the electro-plating type were used to energize these coils, giving between 400 and 2,400 amp., depending on the class of vessel.

The life of these externally fitted strip coils was very short due to their exposed position, and so it was fortunately soon discovered that coils could be run *inside* the ship and produce the same effect. This enabled multi-cored rubber-sheathed stranded copper cable to be used with the standard 220V. high-power supply available in H.M. ships. This system was known as the 'controller' system, as tramway-type controllers were used. By the end of 1940, the controller system was replaced by the P. and I. (permanent and induced) system, so called because the permanent and induced field corrector coils were separately regulated, manually operated stepped resistance regulators being used.

The next step was to introduce automatic course correction to replace the manual adjustment. This was achieved by a transmission unit operated from the gyro-compass circuit. The first systems provided step by step correction, but the latest designs have improved this to give continuously variable correction.

Despite the complexity of the coil systems which had so far been discussed, they by no means represent the complete story of degaussing. Dr. S. H. Ayliffe in his paper on "Processes Applied to a Ship to Alter its State of Magnetization" described three other techniques, 'wiping', 'flashing', and 'deperming' which are also used.

'Wiping' is mainly used to give approximate degaussing to ships which carry insufficient generator power to supply coils. A horizontal coil is wound temporarily round the ship, and, while a heavy current is passed through it, it is wiped up and down the ship's side. By this means the ship may be given sufficient permanent magnetism to compensate for the vertical magnetization previously existing under it. This permanent magnetism will, of course, decay slowly with time, and early wipes were found to remain effective for one to three months. By first 'overwiping', that is, considerably over-magnetizing the ship, and then wiping back to the required value, considerably improved stability is obtained, the effective life being two to three times as long.

'Flashing' is a process somewhat similar to wiping which was employed by the French early in the War. Here the temporary coil was usually floated around the ship on rafts, and pulses of current passed through it. 'Overflashing', like overwiping, gave improved stability. The process was rarely used in Britain.

In contrast to wiping and flashing, which introduced permanent vertical magnetism to compensate existing permanent magnetism plus an approximately constant induced component, 'deperming' aims at removing permanent horizontal components, leaving the induced component to be nullified by course-corrected coils. A flashing process similar to that already described is used, but since the fields tending to reintroduce the magnetism are, on the average, zero (since they change both in magnitude and sign with course), stability is much greater and the treatment rarely needs repeating.

The symposium concluded with a short paper by Messrs. H. C. Wassell and D. A. Turner on "The

Correction of Ships' Magnetic Compasses for the Effects of Degaussing". Mr. Wassell, reading the paper, pointed out that compass correction is an inseparable part of degaussing technique, since magnetic compasses are almost universally used in merchant ships as well as in small warships. The local fields produced by degaussing coils could, if uncorrected, introduce errors of 30–40° into the compass reading, making navigation impossible. Further, owing to course correction, the error would not even be constant. It was necessary, therefore, to set up a coil system near the compass and fed from the same supply as the main coils, to neutralize the local effects. A three-winding composite corrector coil was eventually designed which was placed around the top of the binnacle. Wiping and deperming introduced further problems, as steel structures in the vicinity of the compass had afterwards to be demagnetized separately to prevent their slow magnetic decay introducing unsuspected compass errors.

Further personal reminiscences of war-time experience, which included the task of degaussing 'impossible' ships—or even floating cranes—and building up degaussing stations in localities where a voltmeter was almost the only scientific equipment available, embellished the story and brought the meeting to an interesting conclusion.

H. W. K. Kelly

HIGHER EDUCATION IN THE BRITISH COLONIAL EMPIRE

By Sir FRED CLARKE

RECENTLY it was announced that, on the initiative of the Secretary of State for the Colonies, there has been formed an Inter-University Council for Higher Education in the Colonies, to advise and assist in the development of facilities for higher education in colonial areas now under British administration (see *Nature*, March 16, p. 347). The body thus formed is representative not only of universities in Great Britain and Northern Ireland but also of institutions now enjoying full recognition as universities in Colonial areas. To those who have participated in the movement which has led to this result it must be gratifying to note how wholehearted the response of British universities has been. The result is a Council of great weight and authority, the activities of which will certainly issue in developments of the highest value and importance.

The time has not yet come, perhaps it never will come, when the whole story of the events leading to this action can be told. It is, indeed, fortunate that so many distinguished university men who have played a notable part in the preliminary work find themselves able to serve on the new Council. It may, however, be permissible to say that the story is a long one. Well before the beginning of the Second World War, the Advisory Committee on Education in the Colonies (a long-standing Committee advising the Secretary of State) was already deeply concerned with the need for a positive and active policy directed to the advancement of higher education. It was considering possible lines of action some years before the passing of the first Colonial Development and Welfare Act in 1940 committed Great Britain to the practice of making direct grants from the British Exchequer to assist colonial development. Some of the money thus made available could be used for higher education. Further, a specific sum of half a million sterling a year (now increased to a million) was set aside for the advancement of research, and a strong committee, presided over by Lord Hailey, now advises the Secretary of State on the expenditure of this money.

With such developments taking place, and in view of the ferments set up or intensified by war conditions, the need for clear and comprehensive policy over the whole field became urgent. Accordingly, the Secretary of State appointed two Commissions, one to advise on policy over the whole range (Asquith Commission), the other on the particular policy to be followed in the special circumstances prevailing in West Africa (Elliot Commission). The first of these Commissions found it necessary to carry out a specific inquiry into the needs of the West Indies.

Eventually, therefore, the Secretary of State had before him three reports. Although the West Africa Commission could not agree on a specific policy for that area, opinion on both Commissions was unanimous that a main instrument of action would have to be a strong policy-making and supervising body, representative alike of British universities and of universities in colonial areas. That body is now in existence and has begun to face its task. The remainder of this article will, therefore, be devoted to giving some indication of the nature of the task and particularly of the kind of demands that successful performance of it may make upon British universities.

It is, I think, true to say that the most powerful motive operating in the minds of those who have contributed to this movement was a conviction that a professed policy of encouraging self-government among colonial peoples of the British Empire was unreal so long as nothing systematic was done to provide for the advanced education of the select few who would have to carry the main burden of local self-government. A further motive was the realization that the level of life among colonial peoples would continue to be unduly low until they could be assured of a sufficient and continuous supply of trained technical officers: medical men, engineers, administrators, agricultural experts, veterinary surgeons, and the like. No such supply could be guaranteed by continuing exclusive reliance upon the training resources of Great Britain. Moreover, it was felt that, in some respects at least, native technical officials could be more effectively trained amid the conditions in which they would eventually have to work.

Recently, however, a further consideration of great importance has come to operate. With Africa awakening, the Middle East in ferment, the Far East in motion—no one quite knows whither—and the British West Indies beginning to receive that remedying of past neglect for which they have waited so long, the part now to be played by the civilized tradition of the West comes into question. The British form of that tradition will not now be without powerful rivals. Even though we learn, as we have been learning, the folly of attempting to transplant it bodily into an alien cultural soil, and think rather of translating its values into the native terms of a different social and cultural idiom, there are yet, at the heart of it, certain principles that we may not betray.

Typical of these is the principle that finds expression in the claim to autonomy of institutions for higher education. We should be false to ourselves if we did not insist upon that in all territories under British administration, whatever the local circumstances may be. Indeed, not to do so would be wholly inconsistent with the professed policy of moving in the direction of Colonial self-government.

But autonomy can be granted and sustained only upon conditions. These can be summarized briefly as intellectual integrity and adequate intellectual standards. To assist the nascent institutions in achieving and maintaining these is perhaps the central task of the newly created Inter-University Council. It will recognize, I am sure, that such integrity and the guarantee of such standards are to be found primarily in men and women and only secondarily in institutions. Hence the *staffing* of the growing colleges with a sufficiency of men and women of the right quality must remain a first concern of policy. The Asquith Commission gave much anxious thought to the problem, and no doubt there will be general agreement with its view that extensive use of secondment from British universities will be essential to any solution. If this is accepted, it follows that secondment cannot be left to chance. It must be deliberately planned for, not only in the institutions overseas but also in the organisation and staffing of British universities as well. The call upon them is likely to be considerable. For some time to come, staffs will have to be recruited very largely from Britain. The Asquith Commission estimates that in the next few years some ninety posts of status not lower than that of senior lecturer will have to be filled in West Africa and the West Indies alone. Success cannot be achieved unless British universities in general frame and carry out a policy that makes it possible.

Next to staffing as a security for the fulfilment of the essential conditions we may place adequate provision for research. Here again the Asquith Commission is emphatic. Though it recognizes the important interest of the nascent universities, placed, as they are, in applied research, it also insists upon the primary importance of research of the more fundamental kind. In doing so it emphasizes the part played by the pursuit of pure research in securing precisely that intellectual integrity and that adequacy of standards which have been indicated as the proper conditions of autonomy.

A third security is to be found in the planning of degree courses and the setting of good standards of examination. There is good reason to believe that colonial peoples would themselves resent any suggestion that demands need to be tempered to meet supposed inferior intelligences. They would say, I am sure, that they have no use for a local university the degrees and standards of which are not accepted and recognized in the general fellowship of universities in the British-governed world. Should anyone be in doubt as to the capacity of colonial students to reach the required standards, he may be recommended to spend a few days in contact with students at some such institution as Gordon Memorial College, at Khartoum. His doubts would soon be dispelled.

It is essential, of course, that standards should be well-established and, as it were, automatic in operation before degree-granting powers are conferred on any institution. The period of supervision and control may be a long one. Under the present scheme the necessary guarantee is provided by an adaptation of the external degree of the University of London. It will be for that degree that candidates will prepare during the interim period. Accordingly the University of London is assuming wide obligations in such matters as advice, assistance, adaptations of courses of study, and provision for the participation of local staff in the work of examination. In doing so it will need to co-operate closely with the Inter-University Council. If, however, its full intentions can be carried out, the resulting degree, though 'external' in name, will be very much more than that in fact.

Two other matters require mention. In most areas the only possible medium of instruction must be English. This requirement places a heavy responsibility upon the schools in such areas, particularly upon the secondary schools. The crucial need is for the training of teachers who will not only be competent in English themselves, but also capable of teaching the language competently. Thus is brought to light an immediate service which British universities have neglected hitherto but which they should now set themselves to discharge. It is that of providing advanced training in the teaching of English as a foreign language for those specialists whose services will now be so urgently needed in colonial institutions for the training of teachers. So far as is known, London alone among British universities is providing such facilities.

The other consideration is of even greater importance, and yet can easily be overlooked. It is clear that Colonial universities will fail of their purpose unless they become thoroughly indigenous, responsive at every point to the life and needs of the peoples they are to serve. But they will fail even more disastrously if they are not equally expressive of the great cultural tradition of the West, the expansion of which has brought them into being. In Britain that tradition finds expression in the total life of the community; the university is only the concentrated expression of the life which surrounds it. In most Colonial areas this is not so; the student there will be much more completely dependent in this sense upon his university than are his fellows in Britain. From such a consideration the conclusion is drawn that the new institutions must be wholly residential.

With an Inter-University Council so constituted, it is safe to draw the further conclusion that the peculiar double task of a Colonial university will be well understood and sympathetically assisted.

OBITUARIES

Lieut.-Colonel S. P. James, C.M.G., F.R.S.

By the death of Lieut.-Colonel Sydney Price James on April 17, tropical medicine has been deprived of one of its outstanding personalities. Of Welsh descent, James entered the Indian Medical Service in 1896, fresh from St. Mary's Hospital, where he had studied under Sir Almroth Wright. Soon he was involved in military operations on the North-West Frontier and later in China in the Boxer Campaign of 1900–1. He next found himself in the Government Bacteriological Department and thenceforward was able to devote his whole attention to scientific pursuits. In 1902 his opportunity came in his appointment to the Royal Society's Malaria Commission, and it was then that he forged that close co-operation with his friend, Sir Rickard Christophers, which resulted in their combined researches on this disease, which were vividly illustrated with coloured plates of the local

anophelines. He thus became recognized as one of the leading medical entomologists of India.

From 1899 onwards James was in correspondence with Sir Patrick Manson regarding the metamorphosis of *Filaria bancrofti*, and in 1900 he was able, quite independently, to trace the larval parasite to the proboscis of the mosquito (*Anopheles*), thereby confirming the discovery of G. Carmichael Low. Henceforward he maintained a close and affectionate connexion with the 'Father of Tropical Medicine'. 1912 and the succeeding year found him in Ceylon investigating the distribution of *Aedes ægypti* with reference to the possible spread of yellow fever, as suggested by Manson, and with this object he visited the Panama Canal.

At the outbreak of the War of 1914–18 James served in Iraq as A.D.M.S. to the Indian Expeditionary Force, and then in 1916 he fell victim to cholera in a well-nigh fatal attack of which he afterwards wrote a vivid personal account. Retiring from the Indian Service in 1918, he joined the Local Government Board (afterwards the Ministry of Health), where he rendered invaluable service as adviser on tropical diseases. He soon established a malaria centre at Horton Hospital, where infected anopheline mosquitoes were maintained for the production of therapeutic malaria, and where many strains of these parasites from Central Europe and Africa were studied. Henceforward there emerged from that institution a series of important researches on the clinical and chemotherapeutic aspects of induced malaria, much of which knowledge has been vindicated during the Second World War. It was fitting that he should become the main prop of the Malaria Commission of the League of Nations at Geneva. In 1922 he was appointed to the Epidemic Commission to Poland and during 1923–27 he took a leading part in inquiries on malaria in Russia, Central Europe and the Near East. In 1929 he was dispatched by the Colonial Office for special work on this disease in Kenya.

Retiring from the Ministry in 1936, James joined the Molteno Institute in Cambridge after the death of his friend, Prof. G. H. F. Nuttall; and then, with P. Tate, in 1938 he startled the protozoological world by the discovery of the exo-erythrocytic cycle of *Plasmodium gallinaceum* of the chick, from which he predicted a similar cycle of development of the malaria parasites of man which has not so far been confirmed. He maintained his interest in his favourite subject to the end, and rendered invaluable service as a member of the Chemotherapeutic Committee of the Royal Society. During 1937–39 he served as president of the Royal Society of Tropical Medicine.

In his numerous writings James adopted a vigorous, forcible and clear style. His main publication was "Malaria at Home and Abroad" (1920). As a speaker he was at all times in demand. His delivery and clear diction were outstanding; in personality he was distinguished by peculiar charm, matched by his neat and polished appearance; in demeanour and deportment he more resembled a cavalry officer than a recondite student, and it was to these attributes, combined with a debonair and engaging manner, that his undoubted successes in international conferences were to be ascribed.

James was elected a fellow of the Royal Society in 1931 and created C.M.G. in 1938. He also received the Prix Darling from the League of Nations in 1934. Apart from his work, his chief recreation was yachting.

P. MANSON-BAHR

Prof. Leon Marchlewski

POLISH science has lost one of its most eminent workers by the death on January 18 of Leon Marchlewski, professor of medical chemistry at the University of Cracow.

Marchlewski was born on December 15, 1869, in Wloclawek, a small town in north-western Poland, near the German frontier. He attended the high school in Warsaw and then studied chemistry in Zurich, graduating there while assistant to the distinguished inorganic chemist Lunge. From this period of co-operation with Lunge date the well-known tables of physico-chemical constants of the commonest acids, prepared by the two together. Marchlewski eventually moved to Manchester, to work with E. Schunck, and under his direction entered the field of organic pigments, which became his chief interest for the rest of his scientific life. After five years with Schunck, Marchlewski became laboratory chief with Claus and Rey in Clayton. Early in the present century he returned to Poland, this time to Cracow in the former Austrian part, as chief of the City laboratory for food analysis. In 1906 he was appointed to the chair of medical chemistry at the University of Cracow, where he remained until the beginning of the Second World War.

Marchlewski's principal scientific interest was organic pigments, and chlorophyll was his main subject of research. He began investigations on chlorophyll in Manchester and continued them in Cracow. He and another Polish chemist, Marceli Nencki, who was working at the same time on hæmoglobin, succeeded in demonstrating the very close connexion between the breakdown products of these two substances. His book "Die Chemie des Chlorophylls", published in 1907, was the fruit of many years of work, and was the first monograph of this field of research. The cramped laboratory conditions in Cracow did not permit Marchlewski to keep abreast of advances in chlorophyll chemistry due to the later work of Willstätter and Hans Fischer, but he continued to make valuable contributions to the subject. Thus in 1912 he isolated from sheep bile phylloerythrine, one of the most important degradation products of chlorophyll, making it possible for Hans Fischer to elucidate definitely the structure of chlorophyll. In the last decade the attention of Marchlewski was directed mainly to the ultra-violet spectra of organic compounds.

Marchlewski was an excellent teacher and lecturer, and influenced the many thousands of medical students in Cracow. He played a very important part in university life and was twice elected rector of the University of Cracow. Since 1936 he had been the vice-president of the Polish Academy of Sciences. For many years Marchlewski was a Polish delegate to the International Union of Pure and Applied Chemistry.

Marchlewski was the son of a landed proprietor; he grew up in the country, retaining throughout his life a keen interest in agriculture, and agricultural problems were his main preoccupation apart from chemistry. He was the organiser and first director of an agricultural research institute in Pulawy. He was for many years supervisor of big estates in the Tatra mountains, owned by the nation and later incorporated in the Polish National Park. He was supervisor of the country estates belonging to the Polish Academy of Sciences in central and east Poland, which before the War provided financial

support for the Academy. Marchlewski's interest in agricultural problems accounted to some extent for his political leanings; for he took an important part in the Polish Peasant Party and was elected as representative of the party in the Upper House.

Marchlewski spent the first months of the War in Lwow, under Russian occupation, and so avoided arrest and deportation to the concentration camp at Oranienburg-Sachsenhausen, which was the fate of most of his fellow professors in Cracow after the German entrance into the city. Although living under miserable conditions he wrote his last work, a text-book on physiological chemistry, for he still wished to devote the last resources of his skill to the rising generation of students. Death has prevented him from helping to re-build Polish scientific life.

BOLESŁAW SKARŻYŃSKI

WE regret to announce the following deaths:

Mr. H. B. Maufe, formerly director of the Geological Survey of Southern Rhodesia, on May 8, aged sixty-six.

Dr. E. B. R. Prideaux, formerly reader in inorganic and physical chemistry in University College, Nottingham, on May 8.

NEWS and VIEWS

Royal Society: New Foreign Members

AT a meeting of the Royal Society on May 9, the following were elected to the foreign membership of the Society: Dr. Herbert Spencer Gasser, director of the Rockefeller Institute for Medical Research in New York; Prof. Frédéric Joliot, head of the National Centre of Scientific Research in Paris; Prof. Theodor von Karmán (Pasadena), professor of aeronautics and director of the Guggenheim Aeronautics Laboratory at the California Institute of Technology; Prof. Erik Andersson Stensiö, professor in the University of Uppsala and director of the Riks Museum, Stockholm.

Royal Geographical Society: Awards for 1945–46

THE Royal Geographical Society has announced its medal and other awards for 1945–46:

The King has approved the following awards: Founder's Medal for 1945 to Dr. Charles Camsell, Deputy Minister of Mines and Resources, Canada; chairman, Northwest Territories Council, and president of the Canadian Geographical Society; for his contributions to the geology and geography of the Canadian north and his work in advancing geographical science in the Dominion; Patron's Medal for 1946 to Sub-Inspector Henry A. Larsen, of the Royal Canadian Mounted Police, for his achievement of the North-West Passage in the *St. Roch* from west to east in 1940–42, and from east to west in one season in 1944; Founder's Medal for 1946 to Brigadier Edward A. Glennie, director of the Survey of India, for his work on geodesy in India and his contributions to mapping in the Far East.

The Council of the Society has made the following awards: Victoria Medal for 1946 to Prof. H. J. Fleure for his distinguished service in the advancement of geographical education and his valuable researches into the human aspects of geography; Murchison Grant for 1945 to Lieut.-Colonel W. E. Browne for his work on geodetic survey, and in extending triangulation over long distances at sea; Murchison Grant for 1946 to Lieut.-Colonel C. A. Hart for his work on the application of radar to air survey; Back Grant for 1946 (two years' income) to J. W. S. Marr for his work in connexion with the *Discovery* investigations and his memoir on the South Orkney Islands; Gill Memorial for 1945 to Commander K. E. Oom, Royal Australian Navy, for surveys on the coast of New Guinea during 1942 and 1943 and for subsequent surveys as head of the Australian Hydrographic Department; Gill Memorial for 1946 to Wing-Commander D. C. McKinley as organiser and leader of a series of flights to the north magnetic and north geographical poles in May 1945 in the Empire Air Navigation School aircraft *Aries*.

Institution of Mining and Metallurgy: Awards for 1946

THE Gold Medal of the Institution of Mining and Metallurgy, the highest distinction in the Institution's gift, has been awarded to Mr. Carl Davis, past-president, director and London agent of the Anglo-American Corporation of South Africa, Ltd., in recognition of his services to the gold mining industry in South Africa and West Africa, to mining in Northern Rhodesia, and to mining education. Honorary membership of the Institution has been conferred on Dr. J. G. Lawn, past-president, director and consulting engineer, Johannesburg Consolidated Investment Co., Ltd., in recognition of his services to the Institution as honorary treasurer during 1938–46. The Consolidated Gold Fields of South Africa, Ltd. Gold Medal and Premium have been awarded to Mr. G. Hildick-Smith, manager of Modderfontein B. Gold Mines, Ltd., for his paper on "Shaft Pillars and Shaft Spaces", published in the *Transactions* of the Institution.

American Upper Air Cosmic Ray Expedition

THE National Geographic Society, the United States Army Air Force and the Bartol Research Foundation will jointly conduct a series of four round-trip flights in a specially equipped *B*-29 bomber to investigate the variation with latitude and longitude of cosmic ray intensities. The flights will extend between lat. 50° N. and the magnetic equator, some 20° south of the geographic equator; and studies will be made at altitudes of 5,000, 15,000, 25,000 and 35,000 ft. The trips will not necessarily be continuous, and parts of each flight may even be made at different levels so long as complete round trips at each of the four altitudes can be pieced together. The principal apparatus to be carried in the plane, consisting of multiple banks of Geiger counters, has been designed by Dr. W. F. G. Swann, director of the Bartol Research Foundation. The counters are so arranged that they will record only the particles which move downward vertically. It is hoped to discover the pattern of cosmic ray intensity in a cross-section of the atmosphere extending 4,800 miles northward from the magnetic equator, and reaching from sea-level more than 6½ miles high, and so learn more about the nature of the primary particles entering the atmosphere and breaking down there to

form mesotrons. The investigations will be carried out under the direction of Dr. Lyman J. Briggs, chairman of the Research Committee of the National Geographic Society and formerly director of the National Bureau of Standards. The Army Air Force's co-operation in the project is under the supervision of Major-General Curtis E. Le May, deputy chief of staff in charge of research; the activities of the Bartol Research Foundation will be in charge of Dr. W. F. G. Swann.

South African Council for Scientific and Industrial Research

An initial statement of the objects and policy of the South African Council for Scientific and Industrial Research (The Mint, Pretoria), dated December 1, 1945, has been published over the signature of Dr. B. F. J. Schonland. Emphasizing the need for research in South Africa, the statement points out that it has become essential for the Government to establish an organisation to advise it on the best method of developing resources in scientific manpower and equipment for research to the full, to co-ordinate scientific research for the national welfare and to take charge of certain developments which it considers are badly needed. These functions have been entrusted by the Scientific Research Council Act of 1945 to the Council for Scientific and Industrial Research, a corporate body responsible to the Prime Minister of the Union for formulating and implementing a national policy of scientific and industrial research.

The Council is to consist of a full-time president, who is its chief executive officer, and nine members chosen for their eminence in science and industry. The Council has been created with functions and powers similar to those found necessary for equivalent bodies by Great Britain, Canada, Australia and various Continental countries, and has been made a corporate body outside the Government service to give it the flexibility and freedom essential for scientific research; but it is responsible to Parliament through the Prime Minister for its programme and estimates. Although the Council will derive its basic revenues from a Parliamentary vote, a substantial income is anticipated from other sources, and among the subjects for the development of which it is hoped gifts will be made are research in medicine and national health, special research fellowships, travelling research fellowships, and scientific research institutes, some of a Pan-African nature, in such subjects as meteorology, geochemistry, marine biology, ecology, genetics, nutrition, tropical diseases, oceanography and entomology.

Estimating that South Africa is at present spending about one-sixth of the amount which, in comparison with other countries, it should be spending on research, the statement suggests that industry itself in South Africa should be expending £12,000,000 a year on industrial research, leaving the State to provide £3,000,000 for research in other directions. Looking at the organisation of industrial research as a whole, the statement contemplates that the Council may advise industrialists as to subjects of research, and the Government on research expenditure which should be allowed for tax abatement; and it should foster research associations where desirable. A small number of national research laboratories are required to take over the long-range type of investigation, and the Council proposes to establish immediately a national physical laboratory, a national chemical research laboratory and a building research laboratory. It plans to foster the development of research in universities and similar institutions and to create conditions under which the best science students can be offered a reasonable livelihood in scientific research. In dealing with university research, the Council will direct special attention to encouraging research with no immediate practical object and to improving the conditions under which research is prosecuted and research workers are trained in the universities. The Council will also vigorously explore the needs of the country in the biological sciences basic to agriculture and medicine. It is proposed to develop an information service as a central library and information bureau of the Council, and to establish scientific missions in London, Washington and other centres, which might possibly be headed by scientific attachés.

Research in Britain on Telecommunications

Replying to a debate on telecommunications research raised on the adjournment on May 3, Mr. W. A. Burke, the Assistant Postmaster-General, agreed as to the necessity for increasing both the quantity and quality of such research carried out by the Post Office. He said that it is proposed to use the Dollis Hill premises to the full for research, and the training of engineers will be transferred to the Midlands. With an increase in staff and more accommodation, it will be possible for much more fundamental research to be prosecuted. Mr. Burke also stated that a British telephone technical development committee and the cable manufacturers' technical committee are working in conjunction with the Post Office, and a considerable amount of research has been carried out in this way. The Department of Scientific and Industrial Research has also set up a committee, with Sir Stanley Angwin, chief engineer of the Post Office, as chairman, "to formulate in detail the basic and fundamental research problems in telecommunications which require investigation". Referring to the development work, with which the Dollis Hill Station has hitherto been concerned, rather than with fundamental research, Mr. Burke mentioned ultra-short-wave radio communications, co-axial cables, a scheme for the electro-mechanical facing of letters which would save a good deal of labour, and such war-time achievements as air-raid warning apparatus, specially designed telephone and telegraph circuits for military purposes, improvements to army signals equipment, and the development of equipment connected with defence against air attack.

Talking with the Gullet

The removal of the larynx is a drastic operation, but the use of sulphonamide and penicillin have made it possible to prevent the sepsis which formerly hindered recovery (*Lancet*, March 2, p. 312) The operation involves loss of normal speech, and it is good to learn that remarkable progress has been made in teaching people who have lost the larynx to speak with the œsophagus. Speech can be produced by a stream of air which comes up through the œsophagus instead of through the trachea. The subject must first learn to swallow air. It is not essential that he should do this before the operation, but it is better if he does so. A week or so before the larynx is removed, he is taught to close the glottis and the lips and to expand the chest as he swallows, so that air is aspirated; this can then be brought up again in a noisy belch. When the operation wound has

healed, the swallowing of air and belching is resumed. The trick of this may be learned more easily if a boiled sweet is sucked or if the subject takes acid and alkaline powders which give off gas in the stomach. Very soon it becomes possible to convert the belching of wind into something like speech. Consonants such as *sh* and *ch* are usually the first to be practised. Vowels are then added to them and words like *church* and *scrub* are made. When such explosive consonants as *p*, *d* and *k* have been learnt, other words are added. Before long, several syllables, or one long word, can be spoken with each intake of air, and attempts are then made at short sentences. Pauses for the intake of air cause abnormal grouping of words, and this difficulty is only slowly overcome.

The mechanism of this remarkable achievement has been investigated by asking the subject to swallow a thick barium paste which adheres to the walls of the pharynx and œsophagus so that it can be studied radiographically. It has been found that usually the œsophagus is the air reservoir, but at least one subject used the stomach as an additional one. During speech a narrow channel in the hypopharynx acts as a pseudo-glottis. Photographs of œsophageal speech have been taken by asking the subject to speak into a microphone connected to a cathode ray oscillograph. These show that the pseudo-glottis vibrates very irregularly, and this explains why the œsophageal voice is husky and indefinite in pitch. It has been claimed, however, that a few subjects have learned to modulate their œsophageal voices through a few tones or even through an octave. Subjects who have learnt to speak in this way perform a valuable service by teaching others.

Early Management of Sown Pastures

BULLETIN 34 of the Imperial Bureau of Pastures and Forage Crops, Aberystwyth (obtainable from the Bureau, Central Sales Branch, Penglais, Aberystwyth. 7*s*.), "The Establishment and Early Management of Sown Pastures", has been prepared in collaboration with the Bureau of Plant Industry, Soils and Agricultural Engineering, and the Forest Service of the United States Department of Agriculture, Washington, D.C. It consists of articles, each written by experts, from Great Britain, Canada, Australia, New Zealand and the United States, dealing with that period of grassland husbandry which extends from the preparation of the soil and the composition of the seeds mixture to the management of the sward in its early years. Since the establishment and management of pastures in the tropics have recently been described in Bulletin 31, the discussion here is chiefly confined to the temperate zone, though climatic conditions ranging from semi-arid to humid are covered. The technique of grassland husbandry has been developed as a result of scientific experimentation and trials on a farm basis. The details of this technique, however, vary widely according to the soil, natural vegetation, climate and the purpose for which the herbage is being grown, whether it be for establishing temporary leys in crop rotations, swards on newly cleared forest land or for ground cover on eroded areas. Crop agronomists everywhere will find much of value and interest in the publication, and the large number of photographs included convey a good impression of the country described by each author. An index of the genera and species and a key to the common plant names are useful features of the bulletin.

Marine Biology in the Pacific

THE eastern tropical Pacific has been visited by collectors in a spasmodic manner for a number of years when scientific expeditions in these regions took dredgings at various points or when, as Darwin did in 1835, parties visited the Galapagos Islands. Between 1931 and 1941 a series of ten expeditions was made under the Allan Hancock Foundation, which explored the region more fully and more systematically. The expeditions under the command of Captain Hancock were carried out in the *Velero* III, a Diesel-propelled cruiser of 1,300 tons with a speed of 14 knots and a cruising range of 9,500 miles. She was specially designed and built for the work and fully equipped not only for biological but also for hydrographical work. The first volume of the reports of these voyages is by Prof. C. McLean Fraser (Allan Hancock Pacific Expeditions, Univ. Southern California Press, 1943) and consists of three parts. Part 1 includes the history of the scientific exploration of the region, a detailed description of the *Velero* III, and gives the personnel of each of the cruises. Part 2 treats of the geographical and biological associations. Part 3 provides a general account of the work done together with a list of all the collecting stations with the relevant data. All three parts are very well printed and illustrated with plentiful maps and many splendid plates. We look forward to the appearance of the volumes dealing with the collections made, for if they maintain the standard of the first volume they will form a noteworthy contribution to marine biology.

Carnegie Museum

THE forty-seventh annual report of the Carnegie Museum covers the year ended December 31, 1944, and includes the financial statement as well as a note on publications and on the library and museum (Carnegie Institute, Pittsburgh). Several projects in the field were either sponsored or conducted by the Museum. Dr. A. C. Twomey and Mr. O. F. von Fuehrer visited the west coast of Hudson Bay, near Churchill, where they secured a splendid set of caribou and a few birds of special interest. Dr. J. LeRoy Kay and Mr. J. K. Doutt spent two months in Montana, where they obtained the best collection of big game mammals which the Museum had collected in one venture. In researches in vertebrate palæontology in Montana during the summer months on a somewhat different plan from that of preceding years, numerous new species of fossils were collected, and the material on certain Tertiary forms like marsupials and insectivores from a type locality of the Pipestone Springs Chadron formation was practically doubled. Preliminary plans were made for a far-reaching project for a biological exploration on the northern sector of Labrador or the Ungava Peninsula. The most spectacular display of the year in the galleries was devoted to an interpretation of the Asiatic and Pacific theatres of war from the point of view of the natural history and the distribution of indigenous peoples. The growth of the collections and researches based on a series of scientific specimens have steadily advanced, and some improvements have been made in the laboratories. Educational services were somewhat reduced in scope owing to transport difficulties but were carried on substantially as before. The director's report is supplemented by more detailed sectional accounts of developments and activities.

The British Heritage in Education

STUDENTS of education are conversant with a branch of the subject known as 'comparative education'. An outstanding example is the twenty-first and final volume of the year-book of the International Institute of Teachers College, New York (see *Nature*, **156**, 318; 1945), which provides a comparative view of educational reconstruction in the United Nations. But it would be a great mistake to regard such a view as material for mere imitation. Each nation must work out its own destiny, on the basis of its own history and traditions, but with an eye upon what other nations are doing. This is the keynote of the series of pamphlets emanating from the University of Glasgow and bearing the title "The British Way". What then, ask the editors, is the British heritage and what contribution can it make? Most of the pamphlets so far issued have been by Scottish contributors. "British Ideals in Education" (Glasgow: Craig and Wilson, Ltd., 1*s*. 3*d*.) is the work of Dr. W. B. Inglis, deputy director of studies at Moray House and university lecturer in education, Edinburgh. Dr. Inglis has produced an admirable exposition of his theme, marked by the broad philosophic outlook, as well as by accuracy of detail. Incidentally, he shows the great advantages that accrue from making the series the joint work of Scottish and English writers. His general conclusion is that the old problem of relationships between individual and society must be thought out in terms of new conditions, and that "for many years to come this problem will be in the forefront of educational thought and will be the occasion of stoutly contested action in Britain and elsewhere".

Journal of Colloid Science

MANY readers will by this time have seen the first numbers of the *Journal of Colloid Science*, which is being published by the Academic Press of New York. From the international composition of its editorial board and consulting committee, however, it should also have a wide appeal outside the country of its origin. Publication is to be bi-monthly, and the yearly subscription is 10 dollars. This new journal should perform a useful service in bringing together a great number of related papers now scattered throughout the chemical and biological literature. The first number (January 1946) contains nine papers upon topics ranging over the biological and physical aspects of colloids.

McGraw-Hill Radiation Laboratory Technical Series

FROM its formation in November 1940 until its dissolution at the end of 1945, the Radiation Laboratory, under the direction of Dr. L. A. DuBridge, maintained at the Massachusetts Institute of Technology under contract with the National Defense Research Committee of the U.S. Office of Scientific Research and Development, was the foremost American research and development institution in the field of micro-wave radar. The work done there is to form the basis of the Radiation Laboratory Technical Series to be published by the McGraw-Hill Publishing Co., Ltd. (New York and London). The work is under the general supervision of Louis N. Ridenour, editor-in-chief, and George B. Collins, deputy editor-in-chief. The series as planned consists of twenty-nine titles and a general index. It has been written and edited principally, but not entirely, by members of the Radiation Laboratory. It is the aim of the Technical Series to treat the advances arising from radar work as the basis for the new electronics, rather than in terms of its contributions to radar.

Summer School in Physical Chemistry

IT has been decided to proceed with plans for an advanced course in physical chemistry for graduates, including those in industry and also teachers and junior members of staff in colleges of technology, to be held at the University of Manchester during August 26–September 6. Courses of ten lectures each will be given by Prof. M. Polanyi (Manchester) on "Wave Nature of Matter in Chemistry" and Prof. M. G. Evans (Leeds) on "Molecular Structure and Chemical Reactions". Lectures will also be delivered by Dr. H. A. Skinner (Manchester) on electron diffraction, Dr. H. W. Thompson (Oxford) on the use of infra-red, and Prof. E. G. Cox (Leeds) on X-ray work. Prof. A. D. Ritchie (Edinburgh) will speak on the philosophy of science. During the week-end there will be discussions on "Bond Energies and Isomerization", and on the position of chemists in industry. Accommodation at Dalton Hall can be arranged for those requiring it. Particulars and application forms can be obtained from the Secretary, Department of Physical Chemistry, University, Manchester, 13.

Preservation of Horticultural Boxes

BOXES used for growing seeds and for other garden purposes are not usually very permanent structures. W. C. Moore and J. Bryan show, in a recent short paper (*J. Roy. Hort. Soc.*, **71**, Pt. 3, March 1946), that the use of western red cedar wood is well worth its slight extra cost. Boxes should be made with galvanized nails, and should be dipped for 15 sec. in a solvent type of preservative such as a 25 per cent copper naphthenate solution. They should then last for at least ten years.

Announcements

BRIGADIER O. H. WANSBROUGH-JONES, fellow of Trinity Hall, Cambridge, has been appointed scientific adviser to the Army Council in succession to Sir Charles Ellis, who is a member-designate of the National Coal Board.

THE Council of the Royal Astronomical Society has elected the following to be associates of the Society: Prof. T. Banachiewicz, director of the University Observatory of Cracow; Prof. I. S. Bowen, director of the Mount Wilson Observatory; Dr. A. Couder, astronomer at the Paris Observatory; Prof. A. Danjon, director of the Paris Observatory; Dr. E. Delporte, director of the Royal Observatory of Belgium at Uccle.

THE National Research Council of Canada announces the award of 141 scholarships of a total value of 89,850 dollars for the academic year 1946–47. These comprise sixty-one bursaries at 450 dollars; sixty-four studentships at 750 dollars; and sixteen fellowships at 900 dollars. The 141 students awarded grants this year graduated from twenty-one colleges and universities in Canada, and will be distributed among fifteen different university graduate schools in the Dominion. The number of awards shows a substantial increase over the total for 1945–46, namely sixty-eight.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Organs of Equilibrium in Flying Insects

In a recent unpublished lecture to the Cambridge Natural History Society on analogies between insects and aeroplanes, Mr. J. W. S. Pringle pointed out that many insects lack inherent stability; equilibrium during flight being maintained by appropriate displacements of the wings. Their difficulties are greatest when only a single pair of wings is present. It is in such insects (Diptera, in which the forewings alone are functional, and Strepsiptera with functional hindwings only) that the reduced appendages are transformed into halteres. According to the hypothesis of Fraenkel and Pringle[1], the knobbed haltere serves as an organ of equilibrium. Vibrating in one plane it acts as an alternating gyroscope. If the insect is rotated so that the plane of vibration is changed, lateral shearing forces will be set up in the cuticle of the base of the haltere and will be perceived by the campaniform sensilla.

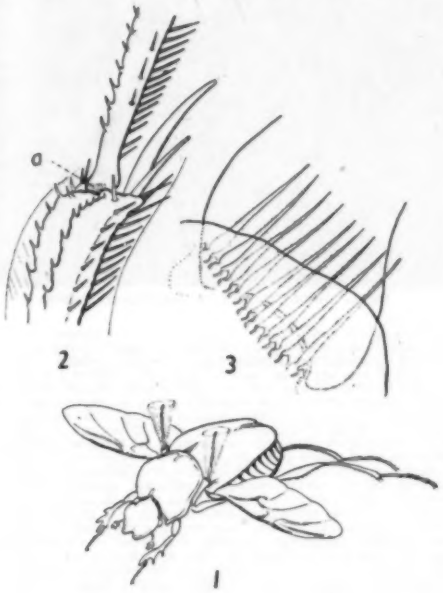

Fig. 1. *Sisyphus* AT THE MOMENT OF TAKING FLIGHT (AFTER V. LENGERKEN)

Fig. 2. TIBIO-TARSAL ARTICULATION OF *Sisyphus*. *a*, DELICATE HAIRS FROM TIBIA OVER BASE OF TARSUS

Fig. 3. DETAIL OF THE ROW OF HAIRS. THE ARTICULATED BASES OF THESE ARE SEEN THROUGH THE OVERLAPPING MARGIN OF THE TIBIA

At the same meeting, the Rev. C. E. Tottenham raised the question of those beetles which extend the hindwings alone during flight and keep the forewings folded to the back. Now v. Lengerken[2] has described how the beetle *Sisyphus* (which flies in this way), immediately before flight and probably during flight, applies the tibia of the middle pair of legs to a groove in the side of the thorax, and upon this rigid base sets the tarsus into intensely rapid vibration (Fig. 1). v. Lengerken regarded these tarsal movements as having a 'stimulatory' function. But in view of the hypothesis of Fraenkel and Pringle, it was interesting to see whether the legs of these beetles are provided with sense organs which might enable them to function as organs of equilibrium.

Through the kindness of Mr. Tottenham, I have been able to examine the legs of *Sisyphus schaefferi* L. and of *Geotrupes sylvaticus* Panzer (as an example of a related beetle which extends its forewings during flight). In neither beetle are campaniform sensilla particularly numerous around the joint. But in *Sisyphus* there is a straight row of some eight or ten delicate articulated hairs, very slightly serrated, extending from the tibia over the base of the tarsus on its outer aspect (Figs. 2 and 3). Hairs of this type are absent from *Geotrupes*. If these are indeed innervated hairs sensitive to touch (and it has not been possible to prove that on dried material), they are ideally placed to detect deviations in the oscillating tarsi, and so enable these to serve as organs of equilibrium analogous to the halteres.

Tactile hairs in the neighbourhood of articulations are well recognized as proprioceptive organs in insects[3,4,5]. Similar hairs are present on the posterior limbs of *Sisyphus* which, so far as is known, are not vibrated during flight.

V. B. WIGGLESWORTH

Department of Zoology,
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March 11.

[1] Fraenkel, G., and Pringle, J. W. S., *Nature*, **141**, 919 (1938).
[2] v. Lengerken, H., *Biol. Zbl.*, **54**, 646 (1934).
[3] Demoll, R., "Die Sinnesorgane der Arthropoden, ihr Bau und ihre Funktion (Braunschweig, 1917).
[4] Diakonoff, A., *Arch. néerl. Physiol.*, **21**, 104 (1936).
[5] Pringle, J. W. S., *J. Exp. Biol.*, **15**, 467 (1938).

Photoperiodism in Jute

Jute is one of the most important fibre crops of Bengal, and two species—*Corchorus capsularis* L. and *C. olitorius* L.—are under cultivation. They are generally sown between March and May and harvested during September–October.

With the recommended varieties D.154 of *C. capsularis* and Chinsura green of *C. olitorius*, a few experiments on the influence of daily light period on the flowering of the plants were made by growing them in suitable pots, and the mean of the dates of the first initiation of visible flower buds of twenty plants being taken as the flowering date in every case.

(1) *Effect of short photoperiods.* (i) Plants sown on April 20 were exposed to short photoperiods of 3 hr. less than the normal light period (which in Calcutta is 12 hr. 20 min. in April, gradually increasing to 13 hr. 27 min. in June and then decreasing gradually to 11 hr. 50 min. in October), two types of treatments being given: in one set the exposure to short photoperiods commenced when the seedlings were 5 days old, and in the second set when they were one month old. The results are given in Table 1.

TABLE 1

April 20.

Species	Control	Vegetative period in days: Short photoperiod treatments: Treatment I from 5 days after sowing: From commencement of treatment	Treatment I: From time of sowing	Treatment I: Earliness in days	Treatment II from 30 days after sowing: From commencement of treatment	Treatment II: From time of sowing	Treatment II: Earliness in days
C. capsularis	114·1	27·6	32·6	81·5	17·4	47·4	66·7
C. olitorius	125·9	22·8	27·8	98·1	14·4	44·4	81·5

Apart from unusually great earliness of 81·5 and 98·1 days in the first set and 66·7 and 81·5 days for the second set for *C. capsularis* and *C. olitorius* respectively, a noteworthy developmental change associated with the flowering is a great development of a branch near the apex of the stem giving the appearance of an apical split. All the plants show the split at flowering, and the early flowering plants on exposure to short photoperiods show the split when the height of stem is about 60 cm. for *capsularis* and 35 cm. for *olitorius*, against the total height reached by normally grown plants of 250 cm. and 300 cm. respectively at flowering. The short photoperiod flowering plants, therefore, remain dwarf and become bushy due to the great development of lateral branches.

(ii) In a second set the plants sown on March 31, 1945, were exposed to 10-hr. and 11½-hr. light periods. There was scarcely any difference in the flowering time, as seen in Table 2.

TABLE 2

March 31.

Species	Vegetative period in days: 10 hr. photoperiod	11½ hr. photoperiod
C. capsularis	38	39
C. olitorius	24	23

(2) *Effect of long photoperiods.* To investigate the effect of exposure to long photoperiods the plants were grown off-season in October and March, when the natural light period is short and the plants have comparatively short vegetative periods.

(i) Sown on September 28, the plants were exposed to long photoperiods of 16 hr., light for the additional period being supplied from 100 c.-p. bulb at a distance of 1 m. The untreated plants of *C. capsularis* and *C. olitorius* exposed to natural light periods (12 hr. to 11 hr. 20 min.) flowered in 36·4 and 26·4 days respectively, while those exposed to long photoperiods did not flower up to the tenth week, when the experiment was discontinued (Table 3).

TABLE 3

October 28.

Species	Vegetative period in days	
	Control	Long photoperiod of 16 hr.
C. capsularis	36·4	Did not flower even in 70 days when the experiment was discontinued.
C. olitorius	26·4	

(ii) Sown on March 1, *C. olitorius* plants were exposed to 14 hr. and 16 hr. light periods, light for the additional period being supplied from a 200 c.-p. bulb at a distance of 2 m. It was observed that while the control set growing in natural short photoperiods flowered in 24 days, none of the sets exposed to long photoperiods flowered even after 12 weeks from sowing, that is, two months after the flowering of the control set, when the experiment was discontinued (Table 4).

TABLE 4

March 1.

Species	Vegetative period in days	
	Control	Long photoperiods of 14 and 16 hr.
C. olitorius	24	Did not flower even in 84 days, when the experiment was discontinued.

Both the species of jute can therefore be called 'short day' plants. The critical light period, though not crucially studied, seems to be near about 12½ hr. from other experiments and observations not reported here. Lowering of light period below this, namely, 11½ hr. and 10 hr. (Table 2) does not produce any further earliness of flowering. The long vegetative period of plants sown in April and May seems to be influenced by the long light periods of the months of May to July more than any other factor.

Earliness of flowering due to short photoperiodic effect is not inherited. Seeds obtained from plants flowering early by shortening the light periods (Table 1) were grown the following year, but the plants did not show any difference in the flowering time from those raised from seeds of normal plants.

From the point of view of fibres, the earliness of flowering due to short photoperiod treatments is of no advantage as these plants remain dwarf and become bushy, making them of little value for fibre. But this has a great significance from the point of view of breeding experiments, and for raising seeds, as it may be possible to raise more than two or three crops in a growing season.

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Feb. 10.

Bacterial Root Nodules in the Zygophyllaceæ

IN addition to the legumes, a number of non-legumes are reported to possess nodules on their roots. Some of these nodules are caused by bacteria while others are caused by Actinomyces. It may be interesting to mention that bacterial nodules are also found on the roots of the Zygophyllaceæ. Among the plants which have been observed to possess such nodules are: *Zygophyllum album*, *Z. coccineum*, *Z. decumbens*, *Z. simplex* (Fig. 1), *Fagonia arabica* and *Tribulus alatus*. They all grow in the poor sandy soils of the Egyptian deserts.

The nodules differ in size, form and position according to the age and nature of the plant; but generally speaking those developed on the main root and near the soil surface are bigger than nodules found deeper in the soil or on lateral branches.

Nodules were also seen on *Zygophyllum coccineum* stem branches. On further examination it was found that the short tender stems and branches cannot maintain the whole body of the plant above ground. The branches tend to bend down and touch the ground owing to the heavy weight of the fleshy leaves and by the action of strong wind and rain. In this way they become infected directly from soil.

The nodules contain bacteroids which are very similar to those of the legumes. Cultures from nodules were made on soil extract mannite agar and the bacteria were found to simulate the *Rhizobium* group. Bacilli enter the root through root hairs and probably through epidermal cells. Cultural experiments under aseptic conditions show that the bacteria are responsible for the production of nodules.

In order to test the effect of these bacteria on the growth of plants, the following experiments were carried out: surface sterilized seeds of *Zygophyllum coccineum* were sown in pots containing sterilized and non-sterilized desert sand (Fig. 2). Half of the sterilized pots were inoculated during sowing with bacterial suspension grown on mannite agar and isolated from *Zygophyllum coccineum* nodules. In all the three sets of pots, seedlings began to appear above ground on the fourth day after sowing. Plants were uprooted at intervals and nodules were seen to develop on the roots of plants grown in non-sterilized and in inoculated soils about the fourth week of sowing. They never appeared during the course of experiment on roots developed in sterile soil. On the fourth week of growth the plants in the three sets were more or less of the same vigour and colour. About the eighth week, the leaves of plants grown in sterilized soil began to turn yellow. They gradually withered and the plants eventually collapsed. Plants grown in the other two sets of pots remained green and vigorous, and later produced flowers and fruits containing normal seeds. A similar experiment was made using rich Nile silt for potting and the results were identical with the first experiment. It seems that these plants cannot thrive unless nodules are developed and that the bacteria provide the hosts with nitrogen. It is very probable that *Zygophyllum* plants grown in sterilized soil, being devoid of nodules, suffered from nitrogen starvation and died early.

Cultural and cross-inoculation experiments are in progress.

Fig. 1. ROOT NODULES ON *Zygophyllum simplex*

A *B* *C*

Fig. 2. *A*, NOT STERILIZED, NOT INOCULATED; *B*, STERILIZED AND INOCULATED; *C*, STERILIZED BUT NOT INOCULATED

I wish to express my thanks to Mr. M. Z. Mahmoud for his kind help during the work.

Y. S. Sabet

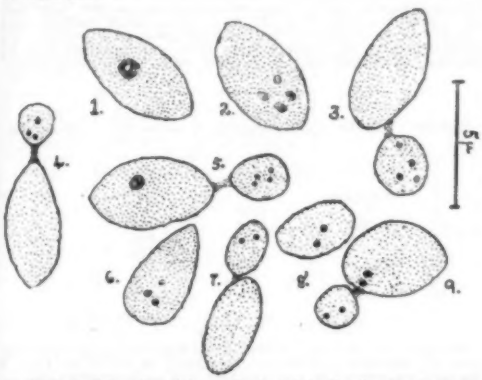
Botany Department, Faculty of Science,
Fouad I University, Cairo. March 1.

Staining the Chromosomes of Yeast by the Feulgen Technique

In spite of the recent controversy[1] whether the Feulgen reaction stains the 'chromosomin' or the desoxyribose nucleic acid in the chromosome, the value of the above test for the identification of chromatin and chromosomes still remains unimpaired. This is more so in the case of the yeast, where volutin granules could easily be confused with chromatin. Kater[2] describes and figures metachromatic granules both in parent and bud during metaphase and anaphase. On the other hand, Caspersson and Brandt[3] showed that while in the resting cells the nucleic acid is confined to the volutin granules, in growing cells these granules disappear and the nucleic acid has a homogeneous distribution in the cytoplasm. The only cytological method of differentiating desoxyribose nucleic acid from the ribose type is said to be by Feulgen's nucleal reaction (Mirsky[4]). Both volutin and chromatin stain by ordinary staining procedures, but only chromatin is stained by the Feulgen technique. Whatever may be the interpretation of the phenomena of nucleal reaction[5], the stained structure in the preparation is identified as chromatin. It appeared to us that a demonstration of the chromosomes of yeasts by the Feulgen technique would establish beyond doubt that yeasts have chromosomes and that these chromosomes conform in their behaviour to similar structures in higher plants.

The material studied was a strain of distillery yeast, the behaviour of the chromosomes of which was interesting[6]. The method of handling the yeast is very important for any successful demonstration of the chromosomes[7]; especially is this the case for demonstration of the chromosomes by the Feulgen technique.

A thin layer of wort in a conical flask was inoculated lightly with a loop of the material from a wort tube culture. After 24 hours a layer of resting cells would usually be found at the bottom of the flask. The supernatant fluid was then poured out, three times its volume of wort added and the flask well shaken in order to ensure uniform distribution. In smears made 50–55 minutes later, under standardized conditions, metaphase and anaphase stages could be seen in the control preparations. Therefore, fresh wet smears were made 50–55 minutes after changing wort, fixed for 30 minutes in osmic vapour[8], dried and stored in 70 per cent alcohol. Seven minutes hydrolysis was found to be ideal, and the slides were kept in a good sample of the stain for 24–48 hours. The slides were counterstained with light green.



In finished slides, the pictures illustrated in the figures were seen. Fig. 1 shows the nucleus in a cell proceeding to division, while the metaphases of the diploid, triploid and the tetraploid are seen in Figs. 8, 6 and 2. The migration of one pair of chromosomes of the diploid to the bud is illustrated in Fig. 9, while Fig. 5 is that of a parent showing a reconstituted nucleus while the chromosomes still remain discrete in the bud. The nucleus of the parent cell appears to lose its power of being stained as it becomes quiescent, and two such examples are illustrated in Figs. 3 and 7, where the attached buds still show discrete chromosomes. As in the control preparations, here also the chromosomes appear lightly glistening.

A comparison of the above with the results already reported[9] would show the similarity of the pictures obtained in Bouin or Carnoy iron haematoxylin preparations and in Feulgen's nucleal reaction.

We are very grateful to Sir J. C. Ghosh and Mr. M. Sreenivasaya for their active interest and encouragement.

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B. Ranganathan

Fermentation Technology Section,
Indian Institute of Science, Bangalore. Nov. 5.

[1] Gulland, J. M., Barker, G. R., and Jordan, D. O., *Ann. Rev. Biochem.*, **14**, 175 (1945).
[2] Kater, J. McA., *Biol. Bull.*, **52**, 436 (1927).
[3] Caspersson, T., and Brandt, K., *Protoplasma*, 35 (1941).
[4] Mirsky, A. E., "Advances in Enzymology", **3**, 1 (1943).
[5] Stedman, E., and Stedman, E., *Nature*, **152**, 267 (1943).
[6] Subramaniam, M. K., and Ranganathan, B., *Nature*, [**157**, 50 (1946)].
[7] Subramaniam, M. K., *Proc. Nat. Inst. Sci.*, in the press.
[8] Robinow, C. F., *Proc. Roy. Soc.*, B, **130**, 299 (1942).

Estimation of Genes in Inheritance of Quantitative Characters

It is well known that the estimation of the number of genes controlling the inheritance of quantitative characters is usually very uncertain. Few workers have published calculations of the number of genes involved, and of these few, "Student" is most frequently quoted (for example, Lush[1], Smith[2]). In 1933, in "The Implications of Winter's Selection Experiment", "Student" estimated[3] that a minimum of 100–300 genes was required to allow the response to selection that Winter attained. However, Fisher, in the same year, pointed out in *Nature*[4] that "Student" had admitted to him in private correspondence "that this calculation fails from over-simplification". In reply to Fisher's criticism, "Student" published his "Calculation of the Minimum Number of Genes in Winter's Selection Experiment"[5]; in which paper he reduced the minimum number to 20–40, an amendment which generally appears to be overlooked.

With regard to his final calculation, "Student" listed the assumptions he made, pointing out particularly those which "cast an element of doubt on the whole calculation". Bearing this in mind, I have made an examination of "Student's" method of estimation.

The following formulæ are applied by "Student" to a normally segregating population, where all genes have equal additive effects. Let the effect due to one gene be k; maximum genetic range, $2n\,k$; genetic standard deviation, $\sqrt{2n\,(pq - \sigma_p{}^2)}\,k$, where p and q represent the frequencies of the corresponding alleles, that is, $p + q = 1$. When $p = q = \frac{1}{2}$, as in a normal F_2 generation, the genetic deviation becomes $\sqrt{\frac{n}{2}}\,k$. For simplicity in this discussion, it is assumed that $p = q = \frac{1}{2}$.

If the maximum range and genetic standard deviation are known, then the number of genes segregating may be calculated as follows:

$$\frac{\text{maximum range}}{\text{genetic standard deviation}} = \frac{2n\,k}{\sqrt{\frac{n}{2}}\,k} = 2\sqrt{2n}.$$

$$\therefore\ n = \left(\frac{\text{maximum range}}{\text{genetic standard deviation}}\right)^2 \times \frac{1}{8}.$$

"Student" has applied this formula (correcting for varying frequencies of p and q), using a genetic standard deviation calculated after three generations of selection. This clearly does not represent the genetic deviation due to segregation from the whole population, since much variation was released only after several more generations of selection. Now, in the use of the formulæ as shown above, it is necessary that the standard deviation should be calculated from the same data as the maximum range; otherwise n represents different quantities, n_1 and n_2, in each formula, so that the ratio could not be simplified as "Student" has done. By using data extending over only a fraction of the range, "Student" under-estimates his genetic standard deviation, and by treating this as total genetic deviation he over-estimates his minimum number of genes.

The foregoing discussion is based on the assumption that gene effects were additive. This is not necessarily so, as "Student" pointed out. An examination of the data reveals a correlation between mean oil content and standard deviation. Moreover, the high-selection line has progressed much further from the original mean than has the low-selection line. This indicates probable geometric action of genes and environment, while dominance and varying frequencies of alleles may contribute further complications. The formulæ for maximum range and genetic standard deviation no longer hold, thus making the whole calculation useless, as suspected by "Student".

To summarize: "Student", in his second paper, reduced the minimum number of genes from 100–300 to 20–40. In doing so, he has probably over-estimated the number of genes by using only a portion of the genetic standard deviation. Furthermore, he ignores the obvious geometric genetic effects, and possible dominance deviations which make the whole method of approach inaccurate. It would therefore seem advisable to cease quoting "Student's" estimate of the minimum number of genes in Winter's selection experiment, especially as "Student" himself doubted the validity of the calculation.

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March 7.

[1] Lush, J. L., "Animal Breeding Plans" (Ames, Iowa, 1943).
[2] Smith, H. H., *Bot. Rev.*, **10** (1944).
[3] "Student", *Eugen. Rev.*, **24**, 293 (1933).
[4] Fisher, R. A., *Nature*, **131**, 400 (1933).
[5] "Student", *Ann. Eugen.*, **6**, 77 (1934).

Seed Setting of Sugar Cane in South Africa

It has been generally believed that sugar cane in South Africa does not produce viable pollen and hence fails to set seed. For this reason, sugar cane seed has been imported for the purpose of breeding new varieties from other countries. When the flowers of a number of varieties were examined by me in 1944, however, several had pollen grains which seemed normal and which the iodine test showed to be starch-filled. Pollen grains were found germinating on stigmas under natural conditions, and were also successfully germinated on the agar medium described by Sartoris[1]. Seed collected from the varieties Glagah, Co. 205 and Co. 301 gave in all thirty-six seedlings; these are believed to be the first true sugar cane seedlings raised from seed set on the African continent. Although seedlings from Amu Darya which, like Glagah, is a variety of *Saccharum spontaneum*, had previously been obtained at the Experiment Station, and although some

varieties had been found with starch-filled pollen-grains, no seedlings of a cultivated type of sugar cane had ever been raised.

During the present season, more than eighty seedlings of Co. 301 and C.P. 34/79 were raised from seed collected from the field. In addition, a number of attempts were made at crossing different varieties. At the beginning of the season, Glagah was the only variety with fertile pollen. Crosses made with Glagah and the varieties Co. 205, P.O.J. 2803, Co. 312 and N : Co. 310 gave a total of 646 seedlings. In spite of the very severe drought during the later part of the season, which resulted in many inflorescences drying out before the seeds had matured, a few successful crosses were made. When Co. 301 was used as a male parent and crossed with Co. 281 and N : Co. 310, 129 seedlings were obtained; as all these varieties are in commercial cultivation in South Africa, some of their seedlings may prove to be well adapted to local conditions.

Overseas sugar cane breeding stations, upon the helpfulness of which South Africa has had to depend for supplies of seed, have few or none of the varieties which have been raised here from imported seed and which are likely to prove of value in further breeding work in South Africa. It would therefore be a great advantage if crosses using these varieties could be carried out locally, even though it should not prove possible to breed sugar cane seedlings on the same scale as is done in other countries.

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[1] Sartoris, G. B., *Amer. J. Bot.*, **33**, 395 (1942).

Pollen-Analysis of Lignite from the Kerguelen Archipelago

THE origin of the present flora of the sub-antarctic islands that comprise the Kerguelen Archipelago has been a frequent subject of discussion and speculation since the time of Sir Joseph Hooker.

An important contribution to this subject was provided in 1934 by Sir Albert Seward and Miss Verona Conway[1], when they described the collection of Tertiary plants discovered near Port Jeanne d'Arc by Dr. de la Rüe. They demonstrated that at least one species of *Araucaria* flourished at Kerguelen in company with other conifers provisionally referred to as *Elatocladus* and a few unassigned ferns and dicotyledons.

The lignites that occur at certain localities in Kerguelen (Mawson)[2] suggested themselves to me as a possible supplementary source of information regarding the Tertiary flora of this Archipelago. So that this avenue of approach could be tested, Sir Douglas Mawson very kindly supplied me with a sample of lignite collected by the B.A.N.Z.A.R. Expedition at Port Jeanne d'Arc.

Preliminary preparations made from this material show that spores and pollen grains occur abundantly and are in a satisfactory state of preservation for identification. Among these, several varieties of winged pollens of podocarpaceous affinities appear to predominate; pteridophyte spores are rather numerous but angiospermous pollens seem to be infrequent. Some large wingless grains that suggest comparison with araucarian pollens have also been observed.

The presence of podocarp pollens supports the recent suggestion put forward by Florin[3] that the two forms of *Elatocladus* described by Seward and Conway were probably members of the Podocarpaceæ.

Detailed identifications and descriptions will be published at a later date.

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Feb. 28.

[1] Seward, A. C., and Conway, V., *Ann. Bot.*, **48**, 715 (1934).
[2] Mawson, Sir D., *Abstracts of Proc. Geol. Soc. London*, May 19, 1933.
[3] Florin, R. K., *Svenska Vet. Akad. Handl.*, 3 ser. **19** No. 2, 32.

Toxicity of D.D.T. to Man

IN view of the present interest in the possible toxic effects of D.D.T. on man and the importance of factual results, the following brief note on the work carried out by the R.N. School of Tropical Hygiene, Colombo, during the period December 1944–September 1945, may be of interest.

Investigations were carried out on fifteen men employed as a spray-operating team. Ten of these men had been employed continuously for a period of nine months and the other five for seven months. With the exception of one Tamil, all were Sinhalese.

The work of the unit consisted of spraying ships and shore establishments against infestation from mosquitoes, flies, bed bugs and cockroaches and of the routine spraying of R.N. establishments in Colombo for dengue control. Knapsack type sprayers were used. The insecticide was a 5 per cent solution of D.D.T. in grade 2 kerosene, prepared by the operators in 40 gallon revolving drums. A mush was first formed in 4 gal. petrol tins, and this was tipped into the mixing drums to which was added the remainder of the kerosene. The men worked in pairs, one operating the sprayer for half the time while the other dealt with furniture and other loose or movable effects and vice versa. On average, a 24-hour (spraying time) week was worked.

Protective Clothing. At the beginning protective clothing was issued, consisting of blue overalls, cap, tropical A.R.P. oiled silk gas cape and gloves, gum boots and gauze mouth pads. In a very short time the men had discarded the gas capes, gloves and mouth pads on account of the intense discomfort from heat, while the gum boots were frequently removed during operations, particularly in ships and on slippery surfaces as the men greatly preferred working with bare feet. All the men wore their overalls open at the neck, and most of them rolled their sleeves up. They washed their hands before the midday meal, and the majority of them washed all over at the end of the day under a cold-water tap in the open.

Degree of Exposure. The nature of the spraying, being mostly indoors and much of it in confined spaces, meant that the men were frequently working in a saturated atmosphere, while many of the sprayers leaked owing to the hard treatment they received and the difficulty in obtaining spares and replacements.

The hands, forearms and upper arms and, to a lesser extent, the faces and feet of the operators were constantly exposed to spray dripping from ceilings and splashing back from walls and to liquid solution leaking from the joints and nozzles of the sprayers. After a day's operations, a white frost of D.D.T. crystals could be seen on the exposed portions of the skin, while the overalls were frequently saturated. All attempts at making the men wear other types of protective clothing failed owing to the heat.

Clinical and Physiological Investigations. Each man was questioned as to his general fitness and received a full clinical examination. Liver function was estimated by the oral hippuric acid synthesis test, hæmoglobin estimations, red- and white-cell counts including differential white-cell counts, examination of urines for abnormal constituents and of stools for parasitic ova, worms and cysts were also carried out. Similar investigations were conducted upon a control series of Sinhalese of comparable age and from the same localities.

The clinical and special investigations and the general demeanour and labour output of the men indicated that no ill-effects whatsoever had been incurred from the prolonged exposure of the skin to the solution and from working in confined spaces in a mist of spray. The operators were keen on their work and a considerable *esprit de corps* existed. Absenteeism seldom occurred.

Detailed findings and a description of the work and environment of the operators will be published shortly in the *Bulletin of Entomological Research*.

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March 25.

Plasma Iron in New-Born Babies

IN an isolated observation, Moore *et al.*[1] found that a new-born infant had a serum iron of 247 γ/100 ml., while the mother at the same time had a serum iron of 58 γ/100 ml. This finding seemed to us sufficiently interesting to justify collecting further data on serum iron in new-born infants. Venous blood from the mother, and blood from the placental end of the newly cut umbilical cord, were used, and plasma iron was estimated by the thiocyanate method[2], using a photo-electric colorimeter for the final colour measurement. The results shown in the accompanying table were obtained from ten full-term infants and their mothers, of whom five were anæmic:

Number	Race	Maternal hæmoglobin (gm./100 ml.)	Maternal serum iron (γ/100 ml.)	Fœtal serum iron (γ/100 ml.)
1	Indian	11·2	130	173
2	,,	11·2	277	207
3	European	—	73	275
4	,,	11·2	13	67
5	Indian	11·2	233	299
6	,,	4·6	130	173
7	,,	9·0	190	170
8	,,	7·6	123	137
9	,,	7·6	70	207
10	,,	8·7	77	87

In eight of the ten pairs of results, the fœtal serum iron was higher than the maternal; of the two exceptions, in No. 2 the value for the maternal serum iron was very high, and contamination may have occurred, while in No. 7 the infant had hydrocephalus and spina bifida, and may have been otherwise abnormal.

Although serum iron is probably bound in some way to proteins, the explanation of the higher fœtal serum iron does not lie in a different serum protein level; for maternal and fœtal serum proteins were estimated in six of the ten cases, and showed no significant difference. There is some evidence that the 'turnover' of blood in the fœtus approaching term is rapid, for the hæmopoietic tissues are active, and at the same time the icterus index is high[3]; and the slight increase in serum iron might be of the same nature as that found in some cases of hæmolytic anæmia. Alternatively, the raised serum iron might be a reflexion of rapid passage of iron from mother to fœtus, which is said to occur mainly in the last month of pregnancy; it is of interest in this connexion that in a five months abortion, not included in the table, the maternal iron was 142 γ/100 ml. and the fœtal only 95 γ/100 ml. From a more general point of view, these results add iron to the long list of substances the concentration of which is different in maternal and fœtal bloods[4].

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[1] Moore, C. V., Doan, C. A., and Arrowsmith, W. R., *J. Clin. Invest.*, **16**, 927 (1937).
[2] Powell, J. F., *Quart. J. Med.*, **13**, 19 (1944).
[3] Whitby, L. E. H., and Britton, C. J. C., "Disorders of the Blood" (London, 1942).
[4] Needham, J., "Biochemistry and Morphogenesis" (Cambridge, 1942).

Coupling of Phosphorylation and Oxidation Processes

THE biochemical phosphorylation reactions may be classified into three main groups: (1) The hydroxyl groups in organic molecules form phosphoric esters reversibly with inorganic phosphates, in which case the free energy of the phosphate linkage is small and of the order 1,000–2,000 calories. (2) The process of esterification is coupled with an oxidation process and is also reversible. The free energy of this type of phosphate linkage is of the order of 10,000 calories. (3) Exchange occurs between the phosphate group and hydroxyl groups in the same molecule or in different molecules, either reversibly or irreversibly. The mechanism of the coupling of the oxidation and the phosphorylation in the second group of reactions has not yet been clarified, although in many instances there is fairly complete information with regard to the chemical substances and stable intermediates taking part in the reactions.

The processes belonging to the second category are presumably those for which the activation energy of the direct addition of phosphoric acid and the elimination of water is too high for the reaction to occur at measurable speeds. A coupled oxidation process is necessary in order that an alternative path be provided. This may arise if oxidation and phosphorylation occur simultaneously. If the reactant were adsorbed on the surface of a suitable substrate which provided the oxidation mechanism, then it might be so activated that it could be phosphorylated by the normal ester mechanism. There is, however, an alternative explanation by which the phosphorylation could occur freely in the aqueous medium.

In the addition of hydrobromic acid to the double bond, the normal process results in the bromine going to the least hydrogenated of the two doubly bound carbon atoms, yielding the most stable isomer. On the other hand, in the presence of hydrogen peroxide, the addition takes place so as to form the less stable isomer. Kharasch[1] explains this oxidation coupling in terms of a chain reaction in which bromine atoms formed by oxidation of hydrogen bromide attack the double bond directly. It is possible that the oxidation-phosphorylation reactions take a similar course.

Little is known about the free radicals derived from phosphoric acid; but there is considerable evidence from Backström's[2] work on the reactions occurring during the oxidation of sulphite and Haber's[3] work on the action of light on sulphite that the HSO_3 radical is present. Analogously, phosphoric acid may yield a free radical in the presence of a high-energy source of oxygen, as follows.

$$\text{(i)}\quad OH + HO.PO_3H_2 \rightleftharpoons H_2PO_4^{\bullet} + H_2O;$$

or

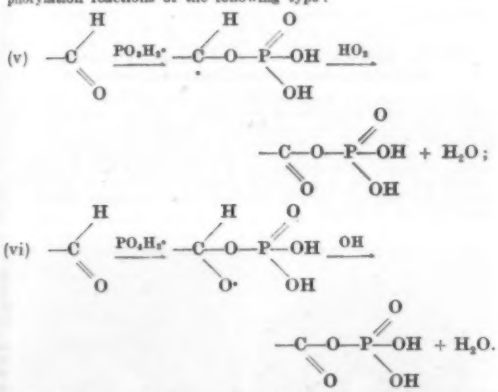
$$\text{(ii)}\quad HO_2 + HO.PO_3H_2 \rightleftharpoons H_2PO_3^{\bullet} + O_2 + H_2O.$$

A possible source of OH and HO_2 in biochemical systems is the interaction of hydrogen peroxide with iron catalysts[4].

$$\text{(iii)}\quad H_2O_2 + Fe^{++} \rightleftharpoons HO + HO^- + Fe^{+++};$$

$$\text{(iv)}\quad H_2O_2 + OH \rightleftharpoons H_2O + HO_2.$$

The free radicals may bring about biochemical oxidation-phosphorylation reactions of the following type:



W. A. Waters[5] has discussed this reaction (V) from the point of view of the interaction of phosphoric acid with a carbonyl radical to give carboxyl phosphate.

The effect of the oxidative breakdown of phosphoric acid would be to permit of the transfer of some of the energy of the oxidation-reduction mechanism to the carbonyl group and its preservation in the phosphorylated carboxyl group. It would also allow of the reduction of the activation energy of phosphorylation.

The lack of evidence bearing on the existence of free radicals from phosphoric acid makes it not worth while pursuing the above theory very far. The suggestion would, however, appear to open up possible lines of investigation into oxidative phosphorylation in reactions occurring in the absence of the special characteristics of the living cell.

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[1] Mayo and Walling, *Chem. Rev.*, **27**, 351 (1940).
[2] Backström, *Trans. Farad. Soc.*, **24**, 601 (1928).
[3] Haber and Wansborough-Jones, *Z. phys. Chem.*, B, **18**, 103 (1932).
[4] Haber and Weiss, *Proc. Roy. Soc.*, A, **147**, 332 (1934).
[5] Waters, W. A., *Trans. Farad. Soc.*, **39**, 145 (1943).

Fibrillar Structure of Cellulose of Bacterial and Animal Origin

IT has been demonstrated both by electron ray and by ordinary and polarized light microscopy that the cellulose cell-wall of green plants has a fibrillar structure[1–3]. Since bacterial cellulose (*Acetobacter xylinum* zoogleæ) and animal cellulose (tunicin) may be assumed to be formed in conditions which differ radically from those which govern cell-wall deposition in green plants, it appeared to be of interest to investigate the microscopic structure of these natural cellulose membranes.

Direct microscopic examination in ordinary light of a thin cellulose zoogleæ formed by *Acetobacter xylinum* on the surface of a suitable culture medium[3] reveals a matrix which seems to be optically empty and within which micro-organisms in random or chain arrangements may be discerned. The picture is indeed very suggestive of that exhibited by a lævan- or dextran-forming organism when it is cultivated on a sucrose medium. The *xylinum* cellulose zoogleæ was found to have a definite substructure, however, when it was examined in suitable conditions under dark-field illumination as described below.

A membrane freshly taken from a culture was cut by frozen section technique either parallel or normal to the membrane surface in slices about 10 μ thick. The sections were immediately mounted in water and examined with a high dry lens using a cardioid dark-field condenser. With this illumination, the material is revealed as a web of numerous slender discrete fibrils among which individual bacteria can easily be discerned as separate entities.

An alternative method of revealing the fibrillar structure of bacterial cellulose is the following: an undried membrane is treated in several volumes of water for a few minutes in a Waring Blendor. The foil is rapidly disintegrated by this treatment and an opalescent fluid which presents properties of a stable colloidal solution results. The fluid is actually, however, a pulp of floating large floccules which are revealed by the dark-field microscope as tangled masses of long fine tenuous fibrils and bacteria.

Animal cellulose (tunicin) was disintegrated in a Waring Blendor and examined with the same technique. It was thus shown that this membrane, too, consists of microscopic fibrils.

The microscopic fibril found in the zoogleæ of *Acetobacter xylinum* gives the typical chemical and physical tests of cellulose. In the dark-field microscope, the fibrils appear to have a uniform width. Their length is difficult to determine as their identity is lost within tangles, but protruding ends up to 20 μ in length have been encountered. The width of the fibrils is much less than that of a *xylinum* organism.

The technique which we have described reveals no spatial orientation of fibrils in relation to the individual bacteria. Very thin and transparent parts of a membrane in incipient formation have been found to be a favourable material for the study of this aspect. In such material, a small number of fibrils is discernible in the field of the dark-ground microscope and the identity of individual fibrils can be followed for a considerable part of their entire length. They are usually straight and form an irregular net the mesh of which is enormous in comparison with the dimensions of the bacterium. The arrangement of the bacteria in the field is irregular and they show no spatial orientation in relation to the fibrils. Furthermore, bacteria separated by mechanical means from the cellulose mesh of a *xylinum* membrane are never seen to carry microscopically visible fibrillar appendages. These observations seem to exclude the possibility that the fibril in *Acetobacter xylinum* zoogleæ is a hair-like outgrowth of the cell-wall. They support the conception that the fibril is formed by an extracellular process of cellulose crystallization.

It may be remarked that the X-ray diffraction analysis of bacterial cellulose accords well with its microscopically fibrillar nature[4]. The demonstration of fibrils as the basis of structure of the *xylinum* zoogleæ suggests an explanation for specific chemical and physical properties of this cellulose. Furthermore, it affords a new approach to the problem of the mechanics of fibril formation.

A detailed report of these findings is in preparation.

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[1] Compare review in "High Polymers", vol. 5, edited by E. Ott (Interscience Publishers, Inc., New York, 1943).
[2] Barnes, R., and Burton, C., *Ind. Eng. Chem.*, **35**, 120 (1943).
[3] Aschner, M., *J. Bact.*, **33**, 249 (1937).
[4] Sisson, W., *J. Phys. Chem.*, **40**, 343 (1936).

Antithyroid Activity of Thiouracil Derivatives

A RECENT report by Anderson *et al.*[1] on the antithyroid activity of a series of alkyl derivatives of thiouracil shows that peak activity is reached at the *n*-propyl compound. A similar series of compounds is under investigation in this Laboratory, and some preliminary results may be of interest as confirming those of Anderson *et al.* in regard to the high activity of the *n*-propyl derivative. The substances under examination comprise methyl, ethyl, *n*-propyl, isopropyl and *n*-amyl thiouracil, and preliminary screening experiments indicated that the *n*-propyl compound was probably the most active of the series. Our experiments are not yet sufficiently complete to allot comparative values to the whole series, but they confirm the preliminary findings of the high activity of the *n*-propyl compound.

The work was carried out on inbred Wistar rats, weighing 100–200 gm., and the compounds were administered by stomach tube daily for 28 days. The rats were then killed and the thyroid gland cleanly dissected, rapidly weighed on a torsion balance and fixed in Bouin's fluid. Typical results were as follows:

Thiouracil			Methyl thiouracil		
No. of rats	Daily dose (mgm./gm.)	Average wt. of thyroid (mgm./100 gm. body wt.)	No. of rats	Daily dose (mgm./gm.)	Average wt. of thyroid (mgm./100 gm. body wt.)
11(6♂5♀)	0·10	12·68	10(5♂5♀)	0·05	15·70
9(4♂5♀)	0·025	8·67	8(5♂3♀)	0·0125	8·37
10(5♂5♀)	0·00625	6·77	9(4♂5♀)	0·003125	6·37
10(5♂5♀)	Nil	4·45		Nil	4·45

n-Propyl thiouracil		
No. of rats	Daily dose (mgm./gm.)	Average wt. of thyroid (mgm./100 gm. body wt.)
7(3♂4♀)	0·10	28·57
7(3♂4♀)	0·025	17·65
7(3♂4♀)	0·00625	18·92
7(3♂4♀)	0·00156	12·22
7(3♂4♀)	Nil	6·30

Histological examination of the thyroids of rats treated with *n*-propyl thiouracil revealed the usual marked hyperplasia with absence of 'colloid' material and increased height of epithelial cells. In some instances, with the lower doses, the degree of hyperplasia was not so marked as would have been expected in view of the large increase in the weight of the thyroid.

The acute oral toxicity of the series of compounds is also being determined. The L.D. 50 by oral administration to rats of *n*-propyl thiouracil is approximately 1·25 mgm./gm. compared with 1·5 mgm./gm. for methyl thiouracil. The interpretation of these figures is rendered difficult by the relative insolubility of the substances and the consequent uncertainty regarding the proportion of the drug absorbed from the gastro-intestinal tract. This uncertainty probably does not apply to the doses used to test the therapeutic action of the drugs, since these amounts were sufficiently small to be given in aqueous solution.

Chronic toxicity tests on *n*-propyl thiouracil, during which oral doses were given daily for four months, showed that, under these conditions, a daily dose of 0·1 mgm./gm. produced a 50 per cent mortality in a group of 10 rats and a dose of 0·05 mgm./gm. a mortality of 10 per cent, the latter rate being identical with that in the control group animals. A comparison of the rate of growth of the animals in these last two groups shows that, whereas the control rats grew steadily throughout the period of the experiment, the rats receiving 0·05 mgm./gm. per day of *n*-propyl thiouracil ceased to grow after the twentieth day and thereafter suffered a slight but steady loss of weight.

We are indebted to Dr. J. F. Martin for supplies of the thiouracil derivatives, and to the Directors of Genatosan Ltd. for permission to publish this note.

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March 8.

[1] Anderson *et al.*, *J. Amer. Chem. Soc.*, **67**, 2197 (1945).

Sugar of Human Semen

In a note added in proof to a recent paper[1], and in a later communication[2], Dr. T. Mann states that the sugar present in seminal plasma —that of the bull, ram and boar were under investigation—has been identified as *d*-fructose. I can offer independent corroboration of this interesting finding in a hitherto unpublished observation made on human semen. In 1942 I had the opportunity of applying to three fresh specimens of human seminal plasma from three separate donors the highly specific skatole colour test for fructose described by Jordan and Pryde[3]. The results were strongly positive, indicating that fructose comprised the bulk of the sugar present in each of the human specimens examined. Thus, the total 'reducing substance' present in the three specimens as determined by the Shaffer–Hartman procedure was 406, 392 and 325 mgm./100 ml. A quantitative application of the skatole test[3] gave corresponding fructose figures of 400, 365 and 290 mgm./100 ml. respectively.

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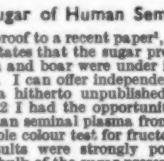
[1] *Biochem. J.*, **39**, 458 (1945).
[2] *Nature*, **157**, 79 (1946).
[3] *Biochem. J.*, **32**, 279 (1938).

A Surface Interaction between Sodium Soaps and certain Sodium Alkyl Sulphates

In the course of study of foaming characteristics of solutions of sulphated detergents in the presence of soap and hard water, Miles and Ross[1] found that the behaviour of sodium lauryl sulphate foams in the presence of calcium chloride, and sodium laurate was accountable on the basis of the formation of the insoluble complex



We find that in hard water and even in distilled water relatively very small quantities of soap (for example, sodium stearate) exert a strong foam-breaking influence on neutral or alkaline solutions of certain sodium alkyl sulphates.

In particular, we have synthesized and studied the sodium *n*-tetradecan-sulphates, and find that the sensitivity of the reaction with soap in distilled water is greatly influenced by the point of attachment of the —SO_4Na group to the tetradecane chain. Thus the foam stability of 1/4 per cent solutions of sodium tetradecan 1- and 2-sulphates is little affected by moderate amounts of soap. With the 3-sulphate interaction becomes evident, and with the 6- and 7-sulphates is extremely marked. For example, when 50 ml. of a 1/4 per cent aqueous solution of sodium tetradecan-6- or -7-sulphate is shaken in a stoppered 100 ml. measuring cylinder, a foam which breaks to half its initial bulk (to top of cylinder) in about 15 minutes is obtained. Addition of 0·25 ml. 1/4 per cent sodium stearate to the tetradecan-sulphate solution just before shaking caused the foam to break completely in a matter of seconds. In a similar experiment with sodium tetradecan-3-sulphate, 1 ml. of 1/4 per cent sodium stearate was required to produce a similar reduction in foam stability.

Smaller or larger amounts of sodium stearate give more stable foams. Those with less sodium stearate approximate in visual characteristics to tetradecan-sulphate foams, and those with more sodium stearate (for example, with 2 ml. 1/4 per cent stearate in the case of the 7-sulphate or with 4 ml. for the 3-sulphate) approximate in visual characteristics and stability to sodium stearate foams. It appears as if the sodium stearate displaces the sodium tetradecan-sulphate from the bubble surfaces in the foam.

A surface-active species so easily displaced from a surface might itself be expected to have poor detergent properties. In this connexion, we have confirmed the results of Miles *et al.*[2] that the detergent properties of isomeric sodium alkyl sulphates diminish markedly as the sodium sulphate group recedes from the end of the hydrocarbon chain. Thus while in detergency sodium tetradecan-1-sulphate is roughly the equal of sodium oleate, sodium tetradecan-7-sulphate is markedly inferior. Also the sodium sulphonate 'Aerosol OT' (sodium sulpho di-octyl succinate), a commercial wetting agent, shows the foam depression effect with soap very strongly and has only poor detergent properties.

The defoaming effect of soap is greatest on its initial addition to the sodium secondary alkyl sulphate solution and gradually diminishes somewhat on standing (half an hour). Thus it appears that besides surface interaction there is some action in bulk. It is hoped to publish further details of this and related work later elsewhere.

I am indebted to the N. V. de Bataafsche Petroleum Maatschappij for permission to publish this note.

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[1] *Ind. Eng. Chem.*, **35**, 1298 (1943).
[2] *Ind. Eng. Chem.*, **36**, 610 (1944).

X-Ray Diffraction Pattern of Bone: Evidence of Reflexions due to the Organic Constituent

In the course of a recent study of rachitic rat bone, it has been found that bone specimens of low mineral content give a collagen type of diffraction pattern superimposed on the pattern given by the inorganic constituent. This supports a claim first put forward by Strauman[1] who, however, based his conclusions on incomplete experimental evidence. The conclusions of later workers that the organic constituent of bone is entirely amorphous[2] or that its diffraction pattern is completely masked by that of the inorganic constituent[3] have not been confirmed.

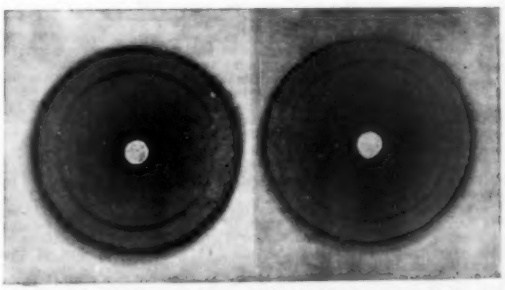

Fig. 1. Rachitic bone Fig. 2. Trypsin-digested Bone

In a recent review of the literature on bone structure, Fankuchen[4] has shown that considerable controversy still exists regarding the exact composition of bone inorganic material, but that the unit cell dimensions have been accurately determined. In the present investigation, all indices have been assigned on the basis of the hexagonal unit cell given by Bale[5]:

$$a = 9{\cdot}37 \pm 0{\cdot}02\ \text{A.} \qquad c = 6{\cdot}88 \pm 0{\cdot}02\ \text{A.}$$

A comparison was made of the diffraction patterns given by intact rachitic bone, trypsin-digested bone and decalcified bone. Figs. 1

and 2 show the types of diffraction pattern given by the two former. The spacings measured from these photographs, the indices assigned and the orientation shown by each diffraction ring are given in Tables 1 and 2. The indices assigned to the bone diffraction pattern by Reed and Reed[6] in their investigation of rachitic bone do not agree with those given below and do not account for the orientation shown by the diffraction pattern.

TABLE 1. RACHITIC BONE

Ring No.	d Å	Indices	Orientation
1	12·8	Organic spacing	Equatorial
2	8·30	$01\bar{1}0$	Equatorial
3 and 4	5·4 to 4·2	Organic	
		$01\bar{1}1$	None
		$11\bar{2}0$	
5	3·44	0002	Meridional
6 and 7	3·17	$01\bar{1}2$	
		$12\bar{3}0$	None
8 and 9	2·87	$12\bar{3}1$	
		$03\bar{3}0$	None
10	2·69	Organic spacing	Meridional

TABLE 2. TRYPSIN-DIGESTED BONE

Ring No.	d Å	Indices	Orientation
2	8·14	$01\bar{1}0$	Equatorial
3	5·28	$01\bar{1}1$	None
4	4·22	$11\bar{2}0$	Equatorial
5	3·45	0002	Meridional
6	3·31	$01\bar{1}2$	None
7	3·22	$12\bar{3}0$	Equatorial
8	2·96	$12\bar{3}1$	None
9	2·86	$03\bar{3}0$	Equatorial
10	2·72	$02\bar{2}2$	None
11	2·55	$03\bar{3}1$	None

The orientation shown by the $01\bar{1}0$ and 0002 reflexions confirmed the preferred alignment of the c axis of the inorganic crystallites approximately parallel to the bone-length, previously reported by Caglioti and Gigante[3]. The broadening of the diffraction rings in evidence in bone (Fig. 1) included $03\bar{3}0$ and $12\bar{3}0$ in multiple rings, and hence no orientation of these could be detected.

Ring No. 10 in Table 1 was oriented on the meridian of the photograph, and must represent a higher order of 0002 if due to inorganic material. The space-group C^6_{3h} assigned to hydroxylapatite and fluorapatite[6,7] precludes the presence of odd orders of 0002; but even if we neglect this supposed halving, the 0003 spacing is 2·29 A., which is considerably different from the observed value of 2·69 A.; and in addition, Ring No. 1 represents a spacing outside the range of the inorganic spacings. These two reflexions must therefore be due to the organic material present, the extreme broadening of the $01\bar{1}1$ and $11\bar{2}0$ spacings being due to the superposition of the broad band of scattering given in that region by proteins of the collagen type.

The improved definition obtained on trypsin digestion and also on calcination[8] indicates that in presence of the collagenous protein of normal bone the inorganic crystallites are considerably deformed. This deformation may arise either by mere mechanical strain of the crystallite due to the packing arrangement in the organic matrix or by the straining of the inorganic structure by interaction of collagen polar groups with the inorganic molecule. It is clear, however, that the difficulties which have arisen in deciding the exact composition of the bone inorganic salt by comparison of the bone diffraction pattern with that of the apatite series of minerals are largely due to the lack of detail in the bone diffraction pattern. Trypsin-digested specimens give detailed diffraction patterns, and this method has the advantage that it is less likely to cause changes in mineral structure than is calcination. It may thus be possible to obtain further information by comparison methods.

The physiological significance of this finding in relation to rachitic bone structure will be discussed elsewhere in co-operation with Drs. G. H. Bell and J. W. Chambers.

Thanks are due to Prof. J. Monteath Robertson for many helpful suggestions and continued interest in the course of this work.

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[1] Strauman, *Helv. Phys. Acta*, **5**, 300 (1932).
[2] Thewlis, *Brit. J. Radiology*, **5**, 353 (1932).
[3] Caglioti and Gigante, *Atti Accad. Lincei*, **23**, 878 (1936).
[4] Fankuchen, "Ann. Rev. Biochem.", **14**, 219 (1945).
[5] Bale, *Amer. J. Röntgen and Rad. Therapy*, **43**, 734 (1940).
[6] Reed and Reed, *Amer. J. Physiol.*, **143**, 413 (1945).
[7] Hendricks, Jefferson and Mosley, *Z. Krist.*, **81**, 352 (1932).
[8] Klement and Trömel, *Z. Physiol.*, **213**, 263 (1932).

Cleavage of Calcite

WE have applied optical interference methods to the examination of cleavage faces of a number of calcite crystals using both multiple-beam Fizeau fringes[1] and fringes of equal chromatic order[2], the crystal being matched against a high-grade quartz optical flat. Cleavage behaviour varies, depending upon the specific crystal. Some crystals show numerous long narrow cleavage strips (see Fig. 2, Fizeau fringes, for a surface 3 mm. × 4 mm.). Others exhibit areas up to 0·2 mm. × 0·2 mm. on which no cleavages appear (magnification of × 100 used). Over such an area the crystal appears to have cleaved true to a single molecular plane.

Fig. 1

Fig. 1 illustrates a typical observation, showing two adjacent fringes of equal chromatic order (high dispersion). The length of the fringes corresponds to a 1 mm. length of crystal. Attention is directed to the extreme sharpness. The small cleaved strip in the centre of the fringe pattern has cleavage steps of only 60 and 72 A. on either side (error ± 3 A.). Other steps of respectively 12, 12, 13 A. (± 3 A.) have been measured; that is, all are simple integral multiples of 12 A. It is to be noted that the X-ray value for the cleavage spacing between rhombohedral faces is 6·1 A.

The majority of the cleavage lines resemble those in mica in that the value of the cleavage step remains constant along the length of the line; but in rare instances this is departed from. In a few particularly noteworthy cases a curious effect has been observed. Application of light pressure to the crystal surface (by pressing on the optical flat) alters the height of these particularly sensitive cleavage strips. In one of the narrow strips (strip dimensions 2 mm. × 0·1 mm., Fig. 2 to left of *A*) bounded by two long cleavage lines, pressure causes the whole strip to move as if rotating about one end, the strip dipping down into, or rising up out of the body of the crystal, by a very small amount. Each successive application of pressure leads to an unpredictable movement of the strip. A typical movement can lead to a change in level of some 100 A. The strip appears to be gliding through this very small distance, tilting through an angle of 1″ of arc

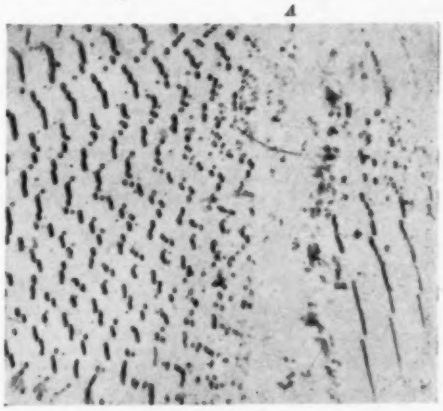

Fig. 2

As in mica, the smooth continuity of the fringes between adjacent cleavage lines indicates that in such a bounded area cleavage has taken place true to a single molecular plane. It seems reasonable to postulate that the cleavage lines are evidence for the existence of some form of coarse mosaic block structure. It would appear that, within a single perfect crystal, cleavage proceeds along a plane until the boundary of that particular single crystal is reached. At this boundary the cleavage jumps and a step results. The gliding of individual blocks, already discussed, supports this view. It is highly probable that the perfect rhombohedral cleavages of calcite permit this gliding to take place.

The observed shapes of the cleavage strips vary considerably in different crystals, being broad rectangles in some and narrow strips in others (for example, 3 mm. × 0·03 mm.). Fig. 2 illustrates Fizeau fringes for an unusual specimen. Within the body of this crystal could be seen a thin extended patch of interference colours, resembling an internal cleavage. The surface shown in Fig. 2 cuts through this region, which is indicated by the letter *A*. The surface here is so ragged that no fringes appear. To the left of *A* the crystal cleaves in long thin strips, and to the right in broad areas. It appears that the growth

of block units differs on both sides of A, doubtless due to change of growth conditions.

A fuller report of the observations made will be communicated elsewhere.

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[1] Tolansky, S., *Proc. Roy. Soc.*, A, **184**, 51 (1945).
[2] Tolansky, S., *Phil. Mag.*, **36**, 225 (1945).

Effect of Duration of Loading on the Strength of Glass

Murgatroyd and Sykes[1] report experiments in which they pre-stressed glass for a prolonged period at a stress thought to be sufficient ultimately to break it, and they afterwards broke the glass in a rapid loading test. They found that the pre-stressing had not significantly reduced the breaking stress in the latter test. Orowan[2] had previously suggested that if the time effect on the strength of glass was due to the spread of initial cracks as a consequence of atmospheric attack, the results of pre-stressing at a load sufficient ultimately to break the glass would be to reduce the strength under a subsequent short-time breaking test. Murgatroyd and Sykes therefore concluded that their results are incompatible with any theory which relates the decay in strength of glass to increase in length of cracks.

Orowan's deduction was based on the interpretation of Griffith's criterion of fracture, which regards crack-spreading at constant surface tension as contrary to the laws of thermodynamics below the Griffith load, but that it proceeds catastrophically as soon as the Griffith load is reached. In a paper I read to the British Rheologists Club in June last year[3], I showed that crack-spreading by Griffith's mechanism in a material of atomic constitution is not catastrophic at the Griffith load. This load is the smallest at which a crack may start to spread by this mechanism. The rate of spreading depends on the rate at which thermal motions overcome atomic energy barriers, which may be very slow even at loads exceeding Griffith's criterion. Catastrophic fracture will not occur until the crack has attained a length such that the strain energy in the material at its end combined with the average thermal motion is sufficient to overcome the average energy barrier. Orowan's prediction therefore needs re-examination.

The severity of atmospheric attack will be a function of stress, and at sufficiently high stress it may possibly be regarded as solution of the glass in atmospheric moisture. For dilute solutions of non-electrolytes, solubility is usually proportional to vapour pressure, and simple thermodynamic calculation leads to the approximate relation

$$\ln \frac{p}{p_0} = \frac{V_m^s X^2}{2ERT}, \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where p and p_0 are the vapour pressures with and without stress V_m^s is the specific volume of the solid, X is the stress, E the Young's modulus, R the gas constant, and T the absolute temperature. In accordance with the Griffith's crack hypothesis, the stress at the end of the cracks is some hundred times the average stress in the material. The vapour pressure at the ends of the cracks when the material is stressed near its breaking load is therefore estimated to be of the order of $10^{30} - 10^{40}$ times that elsewhere in the material. The rate of crack-spreading by evaporation can be estimated from kinetic theory, and if the material does not break until the vapour pressure becomes high relative to that at the end of the crack before it started spreading, the functional relationship between duration of loading t, and average stress f, to cause fracture assuming the whole-time effect is due to evaporation is

$$\left(\frac{A}{f_0^2 t_0}\right)^{1/f_0^2} = \left(\frac{A}{f^2 t}\right)^{1/f^2}, \quad . \quad . \quad . \quad . \quad (2)$$

where A is a constant depending on the properties of the material and the dimensions of the crack. The estimated time-effect due to evaporation is much less than the total time-effect found experimentally for glass. My purpose in quoting equation 2 is that the relationship between solubility and vapour pressure makes it probable that a somewhat similar expression may be expected to give the effect of time on strength due to solution of material at the ends of cracks. The theory used to deduce equation 2 gives for the length of crack (a) at constant load an expression of the form

$$a = -B \log (C - Dt). \quad . \quad . \quad . \quad . \quad (3)$$

For crack-spreading by evaporation, the constants C and D are very small numbers (of the order of 10^{-40}). For example, if the time to break was 10^6 sec., C might be 10^{-40} and D 10^{-46}. For 10^6 sec. the crack-length would be infinite, but for 9×10^6 sec. the crack-length would have increased by only 2½ per cent. The crack-length is thus effectively constant until a critical time is reached at which it increases extremely rapidly. Crack-spreading by solution would be expected to be much more rapid than by evaporation, and if an equation similar to expression 3 holds, the constants C and D would be much greater; but the crack-length may still remain sensibly constant until just before fracture. The results of Murgatroyd and Sykes are not necessarily, therefore, in conflict with the decay in the strength of glass subjected to prolonged loading being due to the spread of cracks.

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[1] Murgatroyd, J. B., and Sykes, F. S., *Nature*, **158**, 716 (1945).
[2] Orowan, E., *Nature*, **154**, 341 (1944).
[3] Gurney, C., *Nature*, **156**, 306 (1945).

Distribution of Energy Levels for the Liquid-Drop Nuclear Model

THE Bohr liquid-drop model, because of the strong interaction between nuclear particles, has proved suggestive in giving insight into some of the fundamental properties of nuclei, particularly the extremely rapid rise in the density of levels as the excitation energy is increased. Taking for the normal modes of surface (capillary) waves, for which the wave number does not exceed k, the asymptotic expression

$$a(k) = \frac{\pi x}{4}, \quad x = \frac{\sigma x^2}{\pi^3}, \quad . \quad . \quad . \quad . \quad (1)$$

σ being the area of the surface, the level separation $D(U)$ is given[1] (ignoring the effect of volume (acoustical) waves) by

$$D(U) = \lambda e^{-S}; \quad . \quad . \quad . \quad . \quad (2)$$

$$S = 3{\cdot}39\,(AU^2/\Gamma P)^{2/7}, \lambda = 2{\cdot}75\,(\Gamma P/A)^{1/7}\,U^{5/7}, \quad (3)$$

where U is the energy of excitation, A is the mass number and Γ, P are each equal to 10 mV. when the nuclear radius R is assumed to be $R = r_0 A^{1/3}$, $r_0 = 2{\cdot}05 \times 10^{-13}$ cm. The values (taken from Bethe[2]) for $U = 10$ mV. and for various values of A are given in the following table.

LEVEL SEPARATION FOR $U = 10$ mV.

A	10	20	50	100	200
$D(U)$	$2{\cdot}8 \times 10^4$	$6{\cdot}1 \times 10^3$	$4{\cdot}8 \times 10^2$	$4{\cdot}6 \times 10$	$2{\cdot}6$
$D_1(U)$	$7{\cdot}8 \times 10^5$	$2{\cdot}4 \times 10^5$	$2{\cdot}8 \times 10^4$	$3{\cdot}9 \times 10^3$	$3{\cdot}4 \times 10^2$
$D_1(U)/D(U)$	28	39	58	85	131

It seems worth while to consider the effect on level-spacing of employing, instead of the asymptotic expression (1), the more accurate expression

$$a(k) = \frac{\pi x}{4} - x^{1/2} + O\left(x^{\frac{17}{18}+\epsilon}\right), \quad . \quad . \quad (4)$$

where the order term (the last term on the right-hand side) is due to Vinogradov[3]. The values $D_1(U)$ of the level separation based on (4) are given in the third row of the table. It can be shown that $D_1(U)/D(U)$ has a minimum for $UA^{1/3} \sim 1{\cdot}25$. The accurate enumeration of the surface modes gives a level-spacing which for heavy nuclei is about 10^2 times larger than the observed value. The level-spacing could be reduced to the order of the observed value by increasing r_0, but the change required is too large to be reasonable.

A detailed paper with other applications of (4) will appear in the *Proceedings of the National Institute of Sciences, India*.

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[1] Bethe, *Rev. Mod. Phys.*, **9**, 86 (§ 53C) (1937).
[3] Vinogradov, *Bull. Acad. Sci. USSR.*, **7**, 313 (1932).

Vibrational Levels in the Red CuO-Bands

ROSEN[1] has recently reported an investigation on the band-spectrum of CuO and given formulæ for the representation of the band-heads, as the result of a vibrational analysis. I have performed a rotational and vibrational analysis of five bands in the red part of the CuO-spectrum[2], and I have computed the following formula for the band-origins:

$$\nu_0 = 16273{\cdot}9 + 285{\cdot}6\,(v' + \tfrac{1}{2}) - 9{\cdot}2\,(v' + \tfrac{1}{2})^2 - [318{\cdot}6\,(v'' + \tfrac{1}{2}) - 4{\cdot}4\,(v'' + \tfrac{1}{2})^2].$$

The constants in this formula differ from the constants in Rosen's formula, particularly in the ground-state, where Rosen's values are about twice as great as my values. I had intended to wait until my investigation on the blue and green bands of CuO, which continues my work on the red band-system, had been completed before drawing further conclusions from the vibrational analysis; but Rosen's report makes a comparison between his and my formula for the red band-system desirable.

1. It can be said that the red band-system of CuO consists of four groups of bands at 6045 A., 6150 A., 6300 A. and 6400 A. These groups appear on my plates of the complete spectrum. The band-heads were measured by Pearse and Gaydon[3]. My values agree with their values. I have deduced my formula from the first two groups, assigned to the sequences beginning with the 1–0 band and 0–0 band. Now, if my formula is applied to compute the bands belonging to the sequences beginning with the 0–1 band and the 0–2 band, it turns out that the bands belonging to these two sequences are neatly arranged around the two latter groups of bands. Rosen's formula does not give the same correspondence between calculated and actually measured bands.

2. The band-heads at 6147·2 A. and 6045·0 A. are not accounted for in Rosen's formula, which means that in Rosen's view these bands must correspond to some sort of doublet structure. This is directly contradicted by the rotational analysis. So far back as ten years ago, Loomis and Watson[4] emphasized that this type of doublet structure was not very probable.

3. The vibrational isotope effect and the rotational isotope effect are in good agreement with my assignment of vibrational quantum numbers.

4. The rotational analysis shows that the B-values of the initial- and ground-state are nearly equal. From this it follows that the values for ω_e in these states should be about the same. They are so in my formula, but in Rosen's formula ω_e for the ground-state is about 2·3 times greater than ω_e for the initial-state.

As soon as my investigations, now in progress, on the rotational and vibrational structure of the blue and green bands of CuO are finished, I propose giving further details on this band-spectrum.

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[1] Rosen, B., *Nature*, **156**, 570 (1945).
[2] Guntsch, A., *Ark. f. Mat. Astr. o. Fys.*, **33A**, No. 2 (1945).
[3] Pearse, R. W. B., and Gaydon, A. G., "The Identification of Molecular Spectra" (London, 1941).
[4] Loomis, F. W., and Watson, T. F., *Phys. Rev.*, **48**, 280 (1935).

Some New Ultra-violet Band Systems of Selenides and Tellurides of Tin and Lead

THE absorption spectra of SnSe, SnTe, PbSe and PbTe molecules have been studied in detail by me in the quartz ultra-violet region, using temperatures from 800° to 1,300° C. Some new band systems have been observed and analysed. The molecular constants obtained from the vibrational analyses of these band systems are given in the accompanying table. The corresponding data for Sb_2 and SbBi, which are isoelectronic with SnTe and PbTe respectively, obtained by Nakamura and Shidei[1], are also included in the table for comparison.

Molecule	Band system	Region (A.)	Molecular constants in cm.$^{-1}$				
			ν_0	ω_e''	$\omega_e''x_e''$	ω_e'	$\omega_e'x_e'$
SnSe	*D*	3434-2881	30809·2	332·0	0·88	192·5	0·82
SnTe	*F*	3666-3456	28545·9	259·5	0·50	98·0	1·0
SnTe	*G*	3512-3298	29071·8	259·5	0·50	200·8	0·3
SnTe	*H*	3309-3165	30818·3	259·5	0·50	201·0	0·6
SnTe	*K*	2386-2184	44282·9	259·5	0·50	217·6	0·30
(Sb_2	II	2333-2178	44780	272·8	0·62	225·0	1·17)
SnTe	*L*	2200-2098	46488·7	259·5	0·50	216·0	0·25)
(Sb_2	III	2168-2048	~47000	272·8	0·62	—	—
PbSe	*E*	2295-2149	45226·2	277·4	0·56	225·0	0·52
PbTe	*D*	2505-2318	41660·8	211·8	0·12	174·3	0·35
(SbBi		2529-2390	40617	220·0	0·50	190·2	0·73)
PbTe	*E*	2251-2105	45918·0	211·8	0·12	160·0	0·50

Some of the band-systems already known in emission[2] have been observed in absorption, for example, the *D*-system[3] of SnO, the *C*-system of SnSe, the *E*-system of SnTe, and analysed. The results agree well with those obtained from the emission spectra. The absorption spectrum[4] of SiO, known previously, has been considerably extended. These and other results are given in detail in a series of papers to appear in the *Proceedings of the National Academy of Sciences, India*.

In the spectrum of PbSe some bands further to the ultra-violet than the *E*-system (for which data are given in the table) have also been observed and measured. Measurements have also been made on the *C*-system of PbTe, which was first observed by Walker, Straley and Smith[5]. An analysis of the two systems will be published shortly.

I wish to express my thanks to Prof. K. S. Krishnan and Dr. K. Majumdar for their guidance and help.

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[1] Nakamura, G., and Shidei, T., *Jap. J. Phys.*, **10**, 11 (1935).
[2] Loomis, F. W., and Watson, T. F., *Phys. Rev.*, **45**, 805 (1934). Barrow, R. F., and Vago, E. E., *Proc. Phys. Soc.*, **55**, 326 (1943). Barrow, R. F., and Vago, E. E., *Proc. Phys. Soc.*, **56**, 78 (1944).
[3] Sharma, D., *Proc. Nat. Acad. Sci., India*, A, **14**, 37 (1944).
[4] Sharma, D., *Proc. Nat. Acad. Sci., India*, A, **14**, 133 (1944).
[5] Walker, J. W., Straley, J. W., and Smith, A. W., *Phys. Rev.*, **53**, 140 (1938).

A Simple Electrophoresis Method

IN the course of an investigation of certain fractions obtained from liver extract, it became desirable to purify quantities of a few grams of these fractions by electrophoresis. The object was a complete separation between the migrating and non-migrating parts of the whole amount of substance subjected to electrophoresis.

It is well known that a non-migrating fraction can be quantitatively isolated, by means of any ordinary electrodialysis apparatus and suitable membranes; but the isolation of the migrating fraction in such an apparatus is rather doubtful if there is a possibility of decomposition at the electrodes, and no membrane to keep the migrating fraction away from these electrodes is known. This difficulty is avoided in an electrophoresis apparatus, but the capacity thereof was too small for our purposes, and it would have been necessary to repeat the experiment many times in order to get sufficient material.

The advantages of the electrodialysis apparatus and of the electrophoresis apparatus can be combined if the migration is allowed to take place not *through* a membrane but *into* a membrane of appropriate thickness and permeability. This led to the design of the following cell: platinum electrode/buffer solution/buffer in agar/substance in agar/buffer in agar/buffer solution/platinum electrode. In this cell the moving boundaries will no longer be affected by gravity differences, convection currents or vibrations. The mechanical separation of the fractions after the completion of the experiment is very much simpler than the usual electrophoresis apparatus, and the concentration of the substance under investigation can be as high as in an electrodialysis apparatus. It resembles the latter also in the current densities that can be applied.

The design of the electrophoresis apparatus for this purpose is quite simple: a straight glass cylinder in a beaker is all that is required. A convenient size for experiments on a medium scale consists of a glass tube, open at both ends, 20 cm. long and 5 cm. wide, in a 600 c.c. beaker. The bottom of the tube is closed by stretching a piece of linen over it and binding it round with cotton. The agar column in the tube is made in the following way. Finely ground agar is suspended in the solution of the substance under investigation. The volume should be 20–25 c.c. and may contain as much as 2 gm. of the substance; the addition of 7–10 per cent agar is sufficient. The pH and conductivity of a suspension of the same concentration is prepared in a suitable buffer. The pH conductivity and agar concentration of this suspension must be made equal to those of the suspension containing the substance. The suspensions are heated on a water-bath to dissolve the agar, then the buffer-agar solution is poured into the electrophoresis tube to a height of 6–7 cm. Air bubbles rising to the surface are removed by means of a glass rod and the solution is allowed to set to a stiff gel. Then the substance in agar is poured on top of it, and after this layer (only 0·5–1 cm. thick) has firmly set, another 6–7 cm. of buffer in agar. The remainder of the cylinder is filled with buffer solution of the same pH and conductivity as the others. The cylinder is placed in the centre of the beaker on two glass rods, in order to keep it at some distance from the bottom, the beaker is filled with the buffer solution, and the electrodes are inserted.

If the beaker is thoroughly cooled, it is possible to apply currents up to 0·5 amp. with buffer-solutions of about 0·1 *N*. It is very useful to have a thermometer in the centre of the tube and one in the beaker outside. The temperature difference should not amount to more than 5° C., otherwise the migration in the centre becomes much stronger than at the surface of the agar column. Even if the moving fractions are colourless, they are sometimes detectable by a slight change in the cloudiness of the agar-gel, mostly by the appearance of a slightly less opaque band.

After the completion of the experiment, the agar cylinder is removed from the glass tube without difficulty and cut into two halves along its central axis. This procedure is preferable to slicing out the desired layers at once since these layers are always slightly bulged. This effect cannot be observed on the cylinder from the outside.

In testing the apparatus and method with 5 per cent flavianic acid, there was quite a distinct zone, containing the greater part of the substance. Even after migrating over a distance of 4–5 cm., the boundaries of this zone were sharp to within 1–2 mm.; but a small fraction of the dye was left behind and was quite evenly distributed for the full distance over which the migration occurred. This is not enough to upset the experiment, and is probably due to adsorption of the flavianic acid on the agar. In our actual experiments we did not observe this phenomenon.

We applied the method in the pH range 3–9, but at pH 9 the agar gel loses much of its rigidity and it does not seem advisable to have the pH much higher. The method is certainly not limited to agar; other substances giving a gel might also be used, though we have had no experience with any of them. The dimensions of the electrophoresis tube mentioned above can be increased if desired, provided the cooling is adequate. We used successfully a square cell with a surface of 8 cm. × 8 cm. and currents of 1·5–2·0 amp. giving fractionations in an hour.

If high concentrations of the buffer solutions are used as recommended, the rise or fall of the liquid level in the cylinder is negligible, and hence the electro-endosmosis through the gel does not disturb the fractionation markedly. This possible source of error should be kept in mind when choosing another gel instead of agar.

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A Criterion for the Reality of Cyclic Variations

IN investigations of natural phenomena the question may arise whether cyclic variations which appear in a series of s experimental (or observational) quantities $a_1\ a_2\ a_3 \ldots a_s$ are real or not. Let k be the number of extrema in this series, where by extremum is meant such a quantity a_m which is either greater or smaller than both its neighbours, a_{m-1} and a_{m+1}. If in the above series long sequences of increasing values alternate with long sequences of decreasing values (that is, if k is very small in comparison with s), the existence of cyclic variations is obvious, and no criterion for their reality is needed. But if these sequences are not very long, such a criterion may be useful; for it seems possible that in a series of quantities distributed at random short sequences of increasing or decreasing values will be found.

So long as no theoretical explanation can be given for the cyclic variations, it will be impossible to decide with complete certainty whether these variations are of real significance or merely accidental. The probability, however, of their reality can be computed; for this probability can be replaced by the probability that a series of s quantities distributed at random contains more than k extrema. If $W(s,k)$ denotes the latter probability, the following recurrence formula[1] holds good for all integers $s \geqq 3$ and $k \geqq 0$:

$$W(s,k) = \frac{k+1}{s} W(s-1, k) + \frac{1}{s} W(s-1, k-1) + \frac{s-k-2}{s} W(s-1, k-2)$$

where, if $k = 0$ or $k = 1$, the following definitions are to be used:

$$W(s-1, -1) = W(s-1, -2) = 1.$$

Starting from $W(3, -1) = 1$, $W(3, 0) = \frac{2}{3}$, and $W(3, 1) = 0$ the above recurrence formula enables us to calculate the probability $W(s,k)$ successively for all integers $s > 3$ and $k \geq 0$. As stated above, this probability is equal to the probability that the cyclic variations shown by a series of s quantities with k extrema are real. The function $W(s,k)$ as given by the above recurrence formula is thus a suitable criterion for the reality of suspected cyclic variations.

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Feb. 28.

[1] A proof of this formula, together with a table of values of $W(s,k)$ and an example, will be published in *Rev. Fac. Sci. Univ. d'Istanbul*, série A, tome 10, and in *Pub. Istanbul Univ. Obs.*, No. 30.

A Chemical Treatment of Wool which Increases its Rate of Felting

WE have noted that treatment of wool with benzoyl chloride in petroleum ether increases the rate of felting on washing in soap solutions.

The fabrics used were pieces of circular knitted fabric of approximately 125 sq. in., weighing about 50 gm., made of 15s yarn of 60s wool. Pieces were cut and each of these was divided to form two rectangles, one of which was treated and the other kept as a control. They are denoted 1 and 1α, etc., in the table. The fabrics were measured wet and air-dried before treatment.

The wool with a moisture content of 12 per cent was treated for three hours at room temperature (22–24°) with 5 per cent benzoyl chloride dissolved in petroleum ether. Two litres of reagent were used for every five pieces. After treatment they were squeezed, plunged into 4 per cent ammonium hydroxide for ten minutes and finally washed in running water.

The treated and untreated pieces were placed together in a washing machine and measured after half an hour and an hour's washing with 3 per cent soap and 2 per cent sodium carbonate at approximately 50°. The results obtained are set out in the accompanying table.

% Shrinkage of untreated fabric		% Shrinkage of treated fabric	
after ½ hr. washing	after 1 hr. washing	after ½ hr. washing	after 1 hr. washing
1 27	41	1α 31	45
2 22	39	2α 37	49
3 26	41	3α 33	46
4 31	41	4α 35	47
5 37	45	5α 39	46
6 27	41	6α 35	46
7 29	43	7α 35	44
8 26	40	8α 32	43
9 25	40	9α 23	41
10 27	40	10α 28	40
Mean 28	41	Mean 33	45

Treatment with acetyl chloride under similar conditions and subsequent washing revealed an increase of doubtful significance in the rate of shrinkage. Benzoylation, therefore, causes the rate of shrinkage to increase. In terms of the normal shrinkage, this increase is of the order of 18 per cent greater after washing for half an hour, and 10 per cent after washing for one hour; and an examination of the samples supports the conclusion that the rate of shrinkage has definitely been increased, for the treated part is in every case visibly smaller than the corresponding untreated sample. The increase in weight due to the benzoylation is negligible. No explanation is offered at the present moment.

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Twist in Wool

HARRIS[1] has directed attention to the tendency of wool to curl, and this, he considers, is due to the established difference in composition, and the assumed difference in physical characteristics, between the cuticle and the cortex of the wool fibre. No quantitative work on this has been reported.

An examination of scoured wool, particularly cross-bred wool, lamb's wool, or fellmongered wool reveals that when a staple passes through the scour without major disturbance, the tip frequently becomes curled, indicating that there is twist in the fibre. This has been investigated by us.

If a greasy wool staple is held at each end and a fibre is dissected out, and without being allowed to twist, is attached to a glass rod at one end and a light glass hook weighing a few milligrams is attached to the other end, then, when the fibre is held freely in air by the rod, it shows a tendency to twist. On the average, in air under room conditions (25° C. and a relative humidity of 50–60 per cent), this approximates to 0·5 revolutions (range 0·12–1 revolution). This twist we have termed the 'free twist'.

If the fibre be afterwards introduced into an atmosphere saturated with water vapour, a further twisting results generally in the same direction; and, on the average, this amounts to five twists (range for 60's fibres, 0·25–18 revolutions). This we have termed 'releasing twist'. From any one staple, the revolutions may be in a clockwise or anti-clockwise direction.

If the fibre be then removed from the saturated atmosphere into room conditions, it is found that a further twisting generally, but not always, in the same direction takes place, the average being about two full revolutions for Merino fibres. When again placed over a saturated atmosphere, an equal number of revolutions takes place in the opposite direction, and this is a reversible and repeatable phenomenon which we have termed 'alternating twist'.

If, after the releasing twist has been set free, the fibre is immersed in water and a number of turns equal to those which have been released are mechanically inserted in the opposite direction, it is found that these turns are retained when the fibre is in an air-dry condition, but that about 90 per cent of them are released when it is again placed over water.

These observations indicate that an isolated wool fibre cannot be regarded as being in a relaxed state apart from atmospheric conditions. Potential torsional forces are varying as the atmospheric conditions vary. The individual fibres do possess a power to move, but in fabrics this movement is mechanically opposed. There can be little doubt, however, that this is a contributory factor in felting, during which fibres are wetted and undergo alternating compression. The tendency to twist might allow the rootward end of the fibre to free itself from some obstacle (another fibre, for example) in the fabric, or to move into the vicinity of some aperture in the fabric through which, due to other forces, the fibre moves, thus facilitating creep and felting.

We have studied the effect of treatments, known to give unshrinkable finishes, on the twist in wool and the results are set out in the accompanying table.

	Alcoholic KOH	Sulphuryl chloride	Wet chlorination	1% caustic soda
Total expected 'releasing twist'	43½ (8)	54½ (7)	57½ (9)	60½ (8)
Total 'releasing twist' found after treatment	18½ (8)	21½ (7)	33 (9)	22½ (8)
Total 'alternating twist' before treatment	18½ (8)	20½ (7)	10½ (7)	15½ (8)
Total 'alternating twist' found after treatment	12½ (8)	18½ (7)	11½ (7)	10½ (8)

Note: The bracketed figures are the number of fibres examined.

In making these studies the number of releasing twists in each 60's fibre was observed in a saturated atmosphere, and this number was then reinserted into the fibre while it was wet, and it was allowed to dry. The wool was then treated with one of the unshrinkable reagents and for comparison some was treated with 1 per cent aqueous caustic soda for 30 minutes.

It can be seen that all these treatments have reduced the 'releasing twist' by approximately 50 per cent. The sulphuryl chloride and wet chlorination have reduced the alternating twist but little, whereas the alcoholic caustic potash and the aqueous caustic soda have reduced the alternating twist by about one third.

These facts emphasize that, in comparison with the other two methods of modifying the shrinkage of wool, alcoholic potassium hydroxide acts in a different manner.

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[1] *Amer. Dyestuff Reporter*, **34**, 72 (1945).

Red Aurora Seen at Ottawa

A DARK plum-red aurora was seen at Ottawa on March 23. Auroral displays occurred on March 23, 24 and 25, but were brightest and most active on March 23. On March 23 an aurora was first observed at 1915 hr. on 75th West Meridian Standard Time (that is, 5 hr. G.M.T.) and an active display continued for several hours. Between 1930 and 2030 a corona pattern persisted. The radiation point was near 5° south of zenith at the beginning and appeared to be displaced slightly eastward during the hour.

The dark plum-red colour showed continuously in the sheaf of rays from zenith to west by north. The intensity varied and so did the detail—rays merging into diffuse patches; but the colour and position of this western sector of the display remained the same for an hour.

A broad greenish-white arc showed in the south sky throughout the hour, maximum altitude of the base being about 15°. Up to 2000 hr. the aurora showed only in the southern sky and overhead. After 2000 hr. it spread to the north sky also.

I have observed auroras many times—aurora australis as well as borealis—but have never before seen red auroras so persistent in time and position. Reds usually seen are brighter and fleeting, associated with the lower tips of rays and with rapid movement.

Five people agreed that a description of the red of March 23 was dark red of a cherry or plum colour. It showed only in the western sector of the display, although sheafs of rays showed in all directions after 2000 hr. and were prominent to the east as well as west before 2000 hr. Lighter red and pink showed occasionally near zenith and in the upper part of the western sector of the display.

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A PAVLOV ANNIVERSARY

A MEETING of scientific societies was held recently in Moscow to commemorate the tenth anniversary of the death of Ivan Petrovitch Pavlov, the great physiologist of the U.S.S.R. Many papers* were read describing fresh work on conditioned reflexes and on various phases of nervous activity: the short abstracts alone are an impressive tribute to Pavlov's memory, as well as a renewed proof of the vigour of Soviet science.

The scientific workers of the U.S.S.R. may well be proud of such a leader. Pavlov combined great originality and driving power with experimental skill of a high order, and he had also the force of character which made him stand as a symbol of scientific integrity in a world divided by political theories. Few who were there will forget his appearance at the International Congress of Physiologists in Edinburgh in 1923. He made it difficult to believe, as many did in those days, that his country had become either a new hell or a new heaven, but it was quite clear that he preferred it to other countries.

The vigour and directness of Pavlov's approach to a problem is shown in all his work on digestion and still more in that on the conditioned reflexes. Since his interests had been concentrated on this field for many years before his death, it is no wonder that the papers read recently at Moscow dealt mainly with neurological topics. Indeed, to the man in the street Pavlov's name recalls the conditioned reflex and nothing else; few but physiologists will remember that he won the Nobel Prize for Medicine in 1904 for his work on digestion before he turned to the study of salivary secretion as a quantitative measure of acquired habits. In this study, which forms the basis of the conditioned reflex theory, Pavlov used only the simplest conceptions and deliberately confined himself to physiological terms. It is easy to point out that there are other ways of looking at the phenomena of learning, that the psychologist is entitled to his say and that the conditioned reflex scheme may not even cover all that the brain can do. Many critics have made these obvious points and have regarded them as raising fatal objections to Pavlov's scheme. They are, no doubt, objections which must be answered by those who regard the conditioned reflex as the clue to all human knowledge and activity, but they have very little to do with its merits as a method of finding out more about the working of the nervous system.

As often happens, so much has been claimed that the solid achievement is in danger of being forgotten. The achievement is recalled by Podkopaiev in his paper at the recent anniversary meeting, when he says that "The method of conditioned reflexes has become a powerful instrument in the study of the behaviour of animals and man". It has been an instrument in constant use to investigate the range of action of the sense organs, the effects of injury of the central nervous system, the action of drugs and of internal secretions, in fact in all problems which demand some means of assessing the effectiveness of cerebral activity. It is a method of the greatest value in the study of the learning process; its value as a means of research in new fields was shown by Pavlov's latest studies of neurosis formation in animals, and by the many researches carried out since his death by his pupils in the U.S.S.R. Loyalty to the theories of such an inspiring leader might have its dangers when the leader was one to whom theories ranked chiefly as a prelude to experiment. But the Pavlov tradition cannot lead to stagnation so long as there are men who remember Pavlov himself with his intense vitality and his eagerness for new discovery.

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* The papers were in five groups: (1) Higher Nervous Activity: P. S. Kupalov, V. K. Fedorov, N. A. Podkopaiev, L. G. Voronin, E. E. Shelvekhman; (2) Evolution of Higher Nervous Activity: A. N. Promptov, G. I. Zobkallo: (3) Biochemical and Electrophysiological Aspects of the Functions of the Nervous System: E. M. Kreps, N. N. Livshitz, V. A. Shidlovsky; (4) Connexions of the Cerebral Cortex with other Parts of the Central Nervous System and with Sense Organs: A. J. Bronstein, A. D. Slonim, M. F. Vassiliev; (5) Adaptive-Trophic Function of the Nervous System: A. G. Ginezinsky, A. D. Ado and N. M. Shamarina, A. D. Ado, M. E. Ersin, L. M. Tshimova and V. N. Smirnov, L. J. Pines and J. U. Zelikin, L. A. Orbeli, N. I. Michelson, E. A. Moisseev and I. N. Zotikova, A. A. Fadeeva, V. N. Chernigovsky, N. V. Zimkin and V. I. Medvedev, M. I. Saprokhin.

INTERNATIONAL CONGRESS OF ANTHROPOLOGICAL AND ETHNOLOGICAL SCIENCES

THE Permanent Council of the International Congress of Anthropological and Ethnological Sciences met at Oxford during April 12–15. At the Second Session of this Congress, held at Copenhagen in 1938, no place was chosen for the third in 1942. The War intervened, and has postponed a full session until 1947. But it has been found practicable to convene the Permanent Council and to resume some of the normal activities of the Congress, through its research committees.

The Royal Anthropological Institute accordingly invited the Council to meet in Britain, and the University of Oxford, through its Sub-Faculty of Anthropology, provided a place of assembly, the delegates being accommodated in New College. Germany and Austria were still inaccessible, but invitations were accepted, and delegates nominated, by every other European country (except Bulgaria, Rumania, and the U.S.S.R.); also by the United States, Mexico, Canada, South Africa, and British India; and Lord Hailey represented the Colonial Office. Delegates from Yugoslavia found the journey too difficult, but Hungary was represented.

The Council was formally welcomed by the Vice-Chancellor, and received in the hall of Corpus Christi College. The death of the president at the Copenhagen meeting, Dr. Thomas Thomsen, had made a vacancy which was filled by Prof. H. J. Fleure, president of the Royal Anthropological Institute. Most of the sessions were devoted to reports and discussions, which will be fully reported in the Royal Anthropological Institute's publication *Man*; but public lectures were given by the Abbé Breuil on "The Bushman Art of South Africa, and its Problems", by Prof. W. E. Le Gros Clark on the "Immediate Problems of Human Palæontology", by Dr. J. S. Weiner on "Physiological Anthropology", and by Miss Amice Calverley on her film-records of Rumanian folk dances. Visits were paid to the Pitt Rivers Museum, the Ashmolean Museum, and the Department of Human Anatomy, where the Sub-Faculty of Anthropology entertained the delegates at tea.

Among the subjects of discussion were the standardization of anthropometric technique, the definition of anthropological terms, the place of anthropology in education, the conservation of aboriginal peoples, and the influence of megalithic culture on other cultures. The scope and relations of the United Nations

Educational, Scientific and Cultural Organisation were explained by Sir Alfred Zimmern and Dr. Julian Huxley, and this new Organisation was welcomed by the Council.

It was agreed, on the formal invitation of the Czechoslovak Government, to hold the full Third Session of the Congress at Prague in August 1947.

After the Oxford meeting, the delegates were received in London by the Royal Anthropological Institute, on the occasion of the Huxley Memorial Lecture by the Abbé Breuil on "The Discovery of the Antiquity of Man".

JOHN L. MYRES

TRANSLOCATION OF COPPER IONS IN PLANTS

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IN *Nature* of December 26, 1936 (p. 1099)[1], a method is described by A. C. Léeman for destroying *Dichapetalum*, a noxious weed of the Transvaal, by plastering a mixture of copper sulphate, calcium chloride and ordinary soil upon a short length of underground stem from which the 'bark' had been removed. Within twenty-four hours, leaves 15 ft. from the main stem were practically dead or dying, the downward movement being much slower (the ratios of the rates calculated from Léeman's figures being about 30 : 1). The movement of the copper ions was followed by placing freshly cut sections in a solution of potassium ferrocyanide, when a more or less deep red-brown colour could be seen where the copper arrived or accumulated. It was found that the movement took place "essentially" in the phloem, and it was suggested that the method could be used for the study of the translocation of solutes as such, the advantage being that the copper enters the intact sieve-tubes laterally by diffusion.

Although realizing that the interpretation of these results is by no means straightforward, the possibilities of the technique seemed worth exploring, and experiments have been made from time to time, as opportunity offered. Some of these appear worth recording in the light of recent work on translocation and on the movements of water in the intact plant. Thus towards the end of May 1937, the mixture was applied to a ring cut near the base of a low-growing shoot of horse-chestnut some 3 ft. in length. Next day the leaves were all dead, and successive sections revealed that the copper had ascended in the phloem almost to the apex of the shoot. The following October, one of the main roots of a large gorse bush was ringed 4–5 in. below the soil surface and the mixture applied to the wound, held in place with a band of adhesive plaster. Here the reaction was slow, a large branch immediately above the ring dying after 7–8 days, while the rest of the bush survived another 4–5 weeks, thus suggesting a connexion with the less active transpiration current of a sclerophyllous evergreen at the approach of winter. More recently (August 1945), the mixture was applied to the ring-barked base of a young willow (about 20 ft. high and some 6 in. in diameter). The only result observed was a slight darkening of the foliage next day. The tree was apparently unharmed, but was cut down later for other reasons, and there was no opportunity for further observations.

In 1942 an attempt was made to follow the path of the copper ions in actively growing woody shoots (*Syringa vulgaris*, *Philadelphus* sp.) 2–3 ft. long, ring-barked and banded at corresponding positions a few inches from the base. Wilting of one or more leaves above the wound followed in 1–3 hours. At the appropriate sign, the shoots were cut and examined, free-hand, by means of successive (spaced) sections. In both kinds of shoots, the copper was evident in the phloem (mainly sieve-tubes) and also in the living cells of the xylem (parenchyma, medullary rays). (This recalls the results of Gustafsen and Darken[2], who found that phosphates (containing radioactive phosphorus) moved upwards in *both* xylem and phloem of rooted cuttings of willow, geranium and *Bryophyllum*.) In both *Philadelphus* and *Syringa* the movement was mainly in the upward direction, but the distances travelled were much greater in *Philadelphus* than in *Syringa*. The day was warm and sunny, and this may have been due to differential water deficit, or to some difference in the depth of the wound in the two plants.

In June 1945, the experiments were repeated more critically and also extended to other types. On this occasion the day was cloudy, after rain, with short sunny intervals, so no water-deficit would be expected; but in order to test this point, each experiment was set up with three similar shoots at about the same level on the plant. One was cut under eosine and examined at once for possible injection in the conducting tracts due to 'negative pressure'; the remaining two were ringed in corresponding positions. One was smeared with 'Vaseline' and wrapped in adhesive plaster, the other well covered with Léeman's mixture and similarly protected. Each pair was cut at the same time (usually after 2–3 hours), the control being cut under eosine while the experimental shoot was at once tested with potassium ferrocyanide. Several different plants were treated and tested on the same afternoon.

Typical results are given in Table 1. It will be noticed that in each case both xylem and phloem are involved, but in varying degrees. In two shoots of *Philadelphus* (1945) and in *Syringa* (1945) downward translocation also occurred involving both xylem and phloem, and in both the downward movement was much less than that in the upward direction (5–6 cm. *Philadelphus*, 4–5 cm. *Syringa*).

TABLE 1. TYPICAL EXPERIMENTS.

Plant	Duration of experiment	Distance travelled above ring: Xylem	Distance travelled above ring: Phloem	Remarks
Syringa vulgaris				
(1) 1942 ..	2-3 hours	3 cm.	1 cm.	
(2) 1945 ..	2½ ,,	15 ,,	21 ,,	
Philadelphus sp.				Lateral shoot ringed near base
(1) 1942 ..	2½ ,,	24 ,,	6 ,,	
(2) 1945 ..	2½ ,,	15 ,,	12 ,,	
(3) 1945 ..	2½ ,,	20 ,,	13 ,,	
Viburnum opulus 1945 ..	2½ ,,	9-10 ,,	9 ,,	
Solidago serotina 1945 ..	3½ ,,	5 ,,	17 ,,	Inflorescence axis ringed near base, just above soil.

In all these experiments there is an element of uncertainty as to possible injury to phloem by exposure, even though this tissue appeared to be intact after removal of the narrow zone of soft cortical tissue. Further observations were therefore made with balsams (*Impatiens glandulifera*), annual plants with sturdy growth having well-developed collenchyma beneath the epidermis, even in the younger parts. Ringing was effected without danger of injuring the vascular tissues beneath by merely stripping off the epidermis.

In the first instance, the stem of a 5-ft. plant was skinned on one side and banded about 3 in. above the base. Next day one or two leaves immediately above the band were drooping and soon died, but no further injury appeared. Investigation of this and other plants similarly treated showed that the collenchyma was very thick-walled in the basal region of the plant, and was only slowly and partially penetrated by the copper ions. The bands were therefore placed about half-way up the main stems, the epidermis being removed for about one-third of the circumference to the height of an inch, when the mixture was quickly applied and the whole enwrapped with layers of adhesive plaster. No subsequent sign of water shortage was seen with plants thus scraped and bandaged unless the Léeman's mixture had also been applied; the addition of 'Vaseline' was found to be quite unnecessary for the shorter time intervals used.

By this means it was found that the copper ions had flooded into all the living cells in the neighbourhood of the wound and had penetrated into phloem, xylem and the peripheral pith cells of the hollow stems. Traced vertically upwards, the red stain was after 2–3 cm. limited to the phloem, and a little higher, only to be found in the *mature* sieve-tubes. In all the treated plants (Table 2), *however short the interval before examination*, the stain was clearly demonstrable in the sieve-tubes all the way to the extreme tip of the stem, but downward penetration (where measured) was much more limited and the path was entirely confined to the sieve-tubes.

TABLE 2. *Impatiens glandulifera* (1945).

Date	Weather	Time of day	Time from banding	Distance travelled: Upwards from top of band	Distance travelled: Downwards from base of band	Notes
June 19	Cool and cloudy	5 p.m.	20 hr. 46 hr.	26 in.	1¼ in.	All leaves of one vertical series killed.
July 6	Bright sun; after rain (1) T. 23°–25° C.	5.45 p.m.	45 min. 4 hr.	37 in.	Not examined	Laminæ crisp—first sign injury.
	(2) T. 23°–25° C.	5 p.m.	30 min.	35 in.	4–5 in.	Laminæ slightly flaccid.
July 7	Bright and warm	8.58 p.m.	5 min.	34 in.	Not examined	Banding 8.58–9.2 p.m. Removed 9.5 p.m. Cut into parts 2 min. One leaf drooping.
July 9	Hot sun	2·58 p.m.	2 min. 60 min.	23 in.	12 in.	All leaves at first slightly flaccid.
July 13	Sun after rain; breeze. (1) Plant in sun	5.50 p.m.	5 min.	27·7 in.	Not examined	Banding 2 min. Cut at 5.5 p.m. Cut into pieces 2 min.
	(2) Plant in shade and sheltered	5.55 p.m.	5 min.	33·75 in.	Not examined	Ibid.

The results of these and other experiments suggest that the path and rate of travel of the copper ions are influenced by the specific nature of the plant and the degree of differentiation of the tissues, apart from possible differences in the permeability and sensitiveness to copper ions. Apparently the water relations of the plant are also important. A water deficit (though probably slight) appears to favour downward in addition to upward movement in *Impatiens*; but the rapid ascent of the ions (July 7 and 13) appeared independently of this. *Impatiens* contrasted strongly with the woody types (Table 1) in that there was no sign of transport in the xylem except near the wound, but this contrast may not prove to be maintained in all circumstances. It is notable that in all these experiments with *Impatiens* there was little diffusion peripherally in the region of the wound, for in banded plants left to their fate, one vertical series of leaves would hang lifeless, while those of the other two orthostichies remained normal for many days after the operation.

Until more is known of such variations, it seems of little use to compare rates of travel in the phloem in different plants; but the rapidity of the upward movement in *Impatiens* shows that maximal rates can only be obtained by using very short time intervals after banding (cf. Table 2, July 13). Thus the technique and timing of the operations are of the first importance. The experiments recorded for July 7 and 13 were performed after rehearsal and practice, but without any assistance; with suitable arrangements shorter time-intervals could be effectively explored. Circumstances interrupted the further prosecution of the work; but these rates (3–4 cm. per min.) are not maximal, since the times include an initial period of diffusion (or possibly of basic exchange) radially inwards which may be a slower process than the upward movement through the sieve-tubes. The rates found are about half that claimed by Léeman, but are much greater than those usually put forward (up to 1 cm. per minute) by workers in this field. It is not easy to see why the transport of mineral ions should be primarily upwards unless influenced directly or indirectly by the transpiration current. In this connexion it is noteworthy that M. P. Both[3], using another species of *Impatiens*, found downward translocation of nitrogen facilitated by differences in humidity, and stopped by placing the receiving and supplying leaves in the same humid atmosphere.

In 1937 and again in 1940, attempts were made to use Léeman's mixture to detect the path of translocation in thalli of *Fucus* and *Ascophyllum*. Selected plants were marked on carefully sited rocks or boulders as the tide receded. In the earlier experiments (at Filey) V-shaped slits were cut near the base of the stoutest stipes available, packed with the mixture (reinforced with a little added soil to give more cohesion) and bound with a rubberized tape. The plants were sought again after twenty-four hours; but some had broken at the wound, while in others the tape had loosened and the salts were washed away.

In August 1940 (at Criccieth), similar experiments were set up, using large plants of *Fucus serratus* (about 2 ft. long, 12–13 dichotomies seriatim, and 300–400 apices, the majority fertile), and also younger plants of *F. vesiculosus*. In these more sheltered waters, with more luxurious vegetation, all the plants survived operation, and by enclosing the bandaged region in an outer coat of stout adhesive sheet rubber, the entrance of sea water was effectively prevented. Three plants of *F. serratus* were treated with the mixture applied just above the second or third dichotomy (about 4 in. above the attaching disk): a fourth plant was treated with sand moistened with

sea water as a control. Two other similar plants were banded about half-way up the thallus, beneath a number of fertile segments.

All the plants were collected twenty-four hours after treatment. The experimental plants were all more or less tinged with a reddish-brown colour for two or three inches above the wound (presumably owing to post-mortem changes due to the poisonous effect of the copper), the rest of the thallus being a clear brownish-green.

Similar experiments were set up with *F. vesiculosus* var. *divaricata*. These each had only six series of dichotomies and about thirty apices of a clear olive-green colour, thus presumably in active growth. In this variety large bladders occur at all dichotomies (excepting those at the lowest levels) as well as in opposite pairs on the wings. In the experiments, the highest well-formed angle-bladders were slit open at the top, filled with the mixture or moist sand and the whole enclosed, while allowing freedom to the young branches on either side.

On collection twenty-four hours later, the branches beyond the bladders were noticeably discoloured excepting at the extreme tips and in small patches at the edges, the others on the same plants, as on the control, remaining olive-green. Below the wound, only an occasional small patch of discoloration was seen.

The plants were all wrapped separately and packed loosely in a tin. In this condition they remained alive for 2–3 days, but their colour was noticeably darkened, with less contrast between the normal and poisoned areas. They were afterwards dried under light pressure.

Cross and longitudinal sections of the dried material were cut (without wetting the razor), placed in a freshly made solution of 10 per cent potassium ferrocyanide for 20–30 min. and examined in dilute glycerine. With this procedure, a marked brick-red colour was seen in the primary medullary filaments of the stipe (or midrib) and also in those secondary filaments surrounding the medulla which had a relatively wide lumen and dense contents. The thick-walled, narrow, secondary filaments had everywhere apparently escaped the poison. The copper was followed upwards nearly to the apex of the thallus of *F. vesiculosus* (that is, 3–4 cm.) and appeared to have travelled for about 6–7 cm. upwards in the basal region of the stipe of *F. serratus*. In the downward direction, on the other hand, there was little sign of transport, and this only for about 2 cm. (*F. serratus*) or less than half a centimetre (*F. vesiculosus*).

Further study of the dried material was deferred until the experiments could be repeated under conditions more favourable for prompt examination, but these results, fragmentary as they are, definitely point to an upward translocation of copper ions (and presumably also of other mineral ions) along the broader medullary filaments. Downward translocation of phosphates and other substances was inferred by Wille[4] from analyses of old and new regions of the thallus of certain *Laminariæ*, but experimental demonstration of the *path* of transport has not been previously given, so far as I am aware, for any of the brown algæ. The method should be capable of further development.

[1] Löeman, A. C., *Nature*, **138**, 1099 (1936).
[2] Gustafsen and Darken, *Amer. J. Bot.*, **24**, 615 (1937).
[3] Both, M. P., *K. Akad. Amst.*, **38** (1935).
[4] Wille, N., "Schwendener's Bot. Untersuch.", 321 (1899).

THEORY OF METALS

By Prof. P. GOMBÁS

Physical Institute of the University for Technical and Economic Sciences, Budapest

In several previous papers[1] I have developed a statistical model of the metals which gives an account of the metallic bond of the alkali and the alkaline earth metals, and permits the computation of the fundamental constants of these metals without the aid of empirical or semi-empirical parameters. According to this model, the metal is composed of the lattice of the positive metal ions and of a uniformly distributed electron-gas consisting of the negative metal electrons (valency electrons). The lattice energy—from which all further conclusions can be derived in a simple way—is assumed to consist of the energy of the metal electron-gas and the interaction energy between the metal electron-gas and the metal ions. The energy of the metal electron-gas is composed of the electrostatic interaction energy, the exchange energy, the correlation energy and the zero-point kinetic energy of the metal electrons according to Fermi. The interaction energy of the metal electron-gas with the metal ions can be divided into three parts: first, the electrostatic interaction energy; secondly, the increase of the kinetic energy as a consequence of the penetration of the metal electron-gas into the electron clouds of the ions; and thirdly, the energy resulting from the exchange interaction between the metal electrons and the core electrons.

This model of the metals can be brought into a more appropriate form for further development and applications if we calculate the interaction energy of the metal electrons with ions—instead of on the basis of the commonly used electrostatic potential V of the ion—on the basis of a modified potential according to a formula I have derived[2]:

$$\Phi = V - \tfrac{3}{4}(3\pi^2)^{1/3}\,\varepsilon\, a_H\, \nu^{1/3},$$

where ε denotes the positive elementary charge, a_H the smallest Bohr radius of the hydrogen atom and ν the electron density of the ions. Using this modified potential, we have to compute the absolutely lowest energy state of the metal electrons in the field of this potential without taking into account the exclusion principle for the metal electrons with regard to the electron states occupied by paired core electrons. This means that we have to neglect the above-mentioned second interaction energy term, the increase of the kinetic electron energy, which leads to an essential simplification. The energy resulting from the exchange interaction of the metal electrons with the core electrons can be computed in exactly the same way as in the case of free atoms[3].

Hence we may express the lattice energy, taking all energy constituents into consideration, in the following way:

$$U = A_0 + \frac{A_1}{R} + \frac{A_2}{R^2} + \frac{A_3}{R^3} + \frac{A_4}{R^4},$$

where R denotes the radius of the elementary sphere containing one metal ion, and the coefficients, $A_i \ldots$, are constants independent of R; their value is determined only by the distribution of the potential and the distribution of the electrons within the ions and by the number of the metal electrons (valency electrons) per atom. All these quantities can be easily calculated. The constant term A_0 is

given by a series expansion of the correlation energy of the metal electron-gas in powers of $1/R$.

From the lattice energy as a function of R, the radius of the elementary sphere R_0, the lattice energy U_0, the sublimation energy S, and the compressibility $\varkappa$ in the state of stable equilibrium can be computed in the same manner as in the publications quoted. It is further possible to compute the work function w according to $w = -\partial U/\partial z$, where z represents the number of metal electrons per metal atom. (It is quite easy to give U for the coefficients A_i as a function of z.) Based upon the Thomas–Fermi–Dirac model of the metal ions, we get, without the help of empirical or semi-empirical parameters for the alkali metals, the data recorded in the accompanying table. R_0 is expressed in 10^{-8} cm., U_0 and S in k.cal./gram-atom, w in e-volts and $\varkappa$ in 10^{-12} cm.^{2}/dyne units; and I should like to emphasize that U_0, S, w and $\varkappa$ were computed by using the theoretical values of R_0. This statistical model cannot be employed in the case of lithium, because in that metal the number of the core electrons is too small.

		Na	K	Rb	Cs
R_0	theor.	2·28	2·51	2·73	2·83
	emp.	2·09	2·58	2·77	2·98
U_0	theor.	−141·2	−130·9	−122·1	−119·0
	emp.	−148·1	−125·9	−120·7	−113·4
S	theor.	23·3	31·4	26·3	29·6
	emp.	30·2	26·4	24·9	24·0
w	theor.	2·35	2·33	2·29	2·28
	emp.	2·3	2·2	2·1	1·9
$\varkappa$	theor.	15·9	22·6	31·0	35·1
$\varkappa$ emp.	extr. to $T = 273°$	16·2	41·7	33	54
	extr. to $T = 0°$	7·7	20·7	—	—

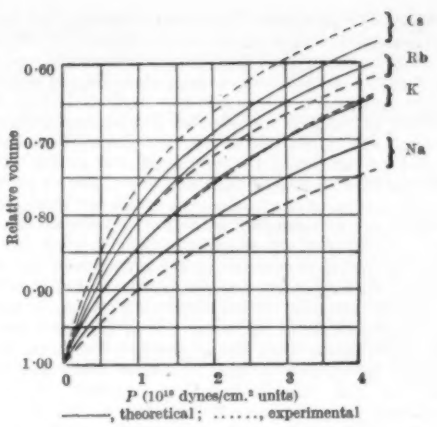
For the sake of comparison we have given in the table, besides the theoretical results, the corresponding experimental values. From the data we can see that the agreement between theoretical and empirical values is quite satisfactory. In the case of $\varkappa$ a direct comparison with experimental values cannot be carried out, because the calculations refer to the absolute zero of temperature whereas the measurements were performed at much higher temperatures. The real empirical values of $\varkappa$ at $T = 0°$ lie between the values we get by linear extrapolation of the empirical values to $T = 0°$ and $T = 273°$. These values are given in the last two rows of the table in cases where the extrapolation could be carried out. As can be seen, we may expect that the theoretical values of $\varkappa$ will agree well with the empirical values at $T = 0°$. The discrepancy between the theoretical and experimental values of w may have its origin in the circumstance that the double layer on the surface of the metals has been neglected throughout the computation of w.

With the help of the formula for U, we can derive the relation between the volume and the pressure at $T = 0°$ by using the equation

$$P = -\frac{dU}{d\Omega} = -\frac{1}{4\pi R^2}\frac{dU}{dR},$$

where P denotes the pressure and Ω the volume of the elementary sphere. These results are in good accord with the experimental values found by Bridgman[4]. The agreement can be well seen in the accompanying figure.

The theoretical results can be further improved by using for the electron distribution of the metal ions the more accurate wave mechanical distribution of Hartree or Hartree and Fock instead of the statistical distribution. Using the Hartree–Fock distribution[5],



we obtain for potassium, in the above-mentioned units: $R_0 = 2{\cdot}59$, $U_0 = -127{\cdot}0$, $S = 27{\cdot}5$, $\varkappa = 26{\cdot}1$.

It is possible still further to improve this theory by the introduction of the field of the modified potential into the statistical model of metals. Thus for alkali metals the eigen-function for the distribution of the metal electrons can be quite easily determined, and one finds[6] practically the same constant distribution which was assumed in the introduction of this article. For the alkaline earths similar computations are possible; the agreement between the theoretical results and the empirical data—as was to be expected—is not quite as good as for the alkali metals, but nevertheless it is still quite satisfactory. A more detailed presentation of the results will be published elsewhere.

[1] Compare especially Gombás, P., *Z. Phys.*, **99**, 729 (1936); the other works are quoted in Gombás, P., *Z. Phys.*, **117**, 322 (1941).
[2] Gombás, P., *Z. Phys.*, **118**, 164 (1941); **119**, 318 (1942).
[3] Gombás, P., *Z. Phys.*, **119**, 318 (1942). The limiting radius r_0 used there can be replaced here by the limiting radius of the statistical Thomas–Fermi–Dirac ions.
[4] Bridgman, P. W., *Proc. Amer. Acad. Sci.*, **72**, 207 (1938). Bardeen, J., *J. Chem. Phys.*, **6**, 372 (1938).
[5] Hartree, D. R., and Hartree, W., *Proc. Roy. Soc.*, A, **166**, 450 (1938).
[6] Gombás, P., *Math. u. Naturwiss. Anz. d. Ung. Akad.*, **59**, 125 (1940).

IMPERIAL CANCER RESEARCH FUND

REPORT FOR 1945–46

DR. W. E. GYE, director of the scientific work of the Imperial Cancer Research Fund, gives, in his report (Pp. 42. London: Royal College of Surgeons, 1946) for the year 1945–46, the good news that war-time difficulties are now being overcome and that projects contemplated in 1939 will soon be resumed. During the War, important work has been done in the Fund's laboratories on the action of war gases on the eye. This included work on lesions caused by mustard gas and trials of British anti-lewisite (*BAL*) (see *Nature*, **156**, 616; 1945). It is hoped that publication of results of studies of the action of other agents used in chemical warfare and of a general consideration of chemical injuries of the eye will be permitted in the future. The Fund's war work has shown that greater consideration should be given to the eye as an experimental medium.

During the past year, the Fund's laboratories have been occupied with work on carcinogenesis, hormones, mammary cancer and the chemotherapy of cancer. The study of the relation of the metabolism of sulphur to the occurrence of cancer has indicated that disturbance of sulphur metabolism impairs carcinogenic activity, the inhibition of sulphur metabolism being parallel to inhibition of carcinogenic activity. This work has also indicated that sulphur plays no part in the elimination of carcinogenic substances. The results obtained are in harmony with the hypothesis that a primary action of carcinogens is their fixation to unknown sulphydryl-containing constituents of the cell.

Work on mammary cancer has included a study of various methods of administering the milk agent and experiments on the recovery of Bittner's factor from milk taken from the stomachs of sucking mice fed by high-cancer strains. Further work has been done on the tumour-inducing activity of dried mammary cancer tissues from mice of several high-cancer strains and on the interaction of formative stimuli on mouse mammæ of high- and low-cancer strains.

The caloric intake of the host influences the development of spontaneous and transplantable tumours; and dietary restriction inhibits the development of mammary tumours in mice of high-cancer strains. In some instances, this happens even after œstrogen treatment. Because many substances are now available, especially thiourea and its derivatives, which block the synthesis of thyroxine and therefore lower the basal metabolic rate, causing also hyperplasia of the thyroid, it seemed possible that substances of this kind might exert on the development of mammary cancer an effect similar to that produced by dietary restriction. Preliminary results of investigation of this hypothesis indicate that thiourea administered in drinking water to mice suffering from cancer inhibits, or at least delays, the appearance of mammary tumours in these mice. The way in which thiourea exerts this effect is being studied.

Chemotherapeutic work has included studies of the possible therapeutic value of large numbers of pure chemical substances; but no substance has yet been found which exerts a specific effect upon cancer cells. Substances are known which induce hæmorrhages in tumours. Among these are polysaccharides extracted from bacterial filtrates and the alkaloid colchicine. Colchicine also arrests cell division at the metaphase by preventing the formation of the mitotic spindle. Work in the Fund's laboratories has, however, failed to inhibit mitosis of malignant cells without also inhibiting at the same time the mitoses of other cells. Further study of this action of colchicine seems, nevertheless, to be promising. The Fund's workers have also found that colchicine administered to mice with transplantable tumours causes extensive hæmorrhages into the tumours, followed by shrinkage of their size and sometimes by ulceration of their surfaces. In exceptional instances, complete regression of the tumour followed. The greatest effect was exerted on soft, highly cellular and rapidly growing tumours. Similar effects were exerted by bacterial filtrates. Study of the action of pellets of stilbœstrol, which were introduced subcutaneously, upon tumours the sensitivity of which to colchicine had been determined, showed that stilbœstrol did not influence the growth of these tumours unless it was given in doses which were toxic to the animal. The report discusses each of these lines of work in further detail.

There has been, during the year 1945–46, an increase of £5,531 in subscriptions, and the Fund has received in legacies a greater sum than that contributed in this form during any previous year. Many of the staff have been away on war service, so that less has been spent upon wages, salaries and equipment; but wages and salaries are now higher than they were and all costs have risen. The increased activities of the coming year will, therefore, involve greater expenditure. The Fund, which seeks not only to remove one of the greatest scourges of mankind, but also to contribute fundamental facts to our knowledge of the biological basis of disease, is worthy of every means of support. G. LAPAGE

FOOD CONDITIONS IN OCCUPIED POLAND

A RECENT publication dealing with Polish problems* presents an attempt to assess "the wartime diet of the different categories of the population of Poland so as to obtain an approximate picture of the dietary needs of the population and to plan a food relief accordingly". It was published before the War ended and the assessment had to be made on incomplete information, but the probability is that the actual situation was even worse than appears—at any rate for the urban population.

The information used was that published by the German authorities themselves regarding the official food rationing system in occupied Poland. Where official information was not available, no detailed analysis was attempted; but an outline of the position is given so far as it could be judged.

Pre-war, Poland was chiefly engaged in agriculture, and prior to the overrunning of the agricultural areas in Western Europe, the Germans clearly hoped to draw good food supplies from this, the first of their occupied territories. All their planning was directed to this end.

The occupied territory was divided into two parts. That in the West (Wartheland) was incorporated into the Reich, and the remainder was classed as the "General Government" area. Food rationing and living conditions in general differed in the two areas.

In Wartheland, Polish farmers were expropriated and replaced by German colonists, and plans were drawn up for an increased agricultural production. Food regulations were detailed and seem to have been put into practice with great thoroughness. Germans, Poles and Jews were issued with ration cards of different colours and the distinction was emphasized in many other ways. The amounts obtainable on the ration were varied from period to period but were always highest for Germans and lowest for Jews; differences in quality were given a similar distribution: for example, wheat bread was given to Germans, Poles received adulterated rye bread; Germans received butter for their fat ration, Poles received rape-seed oil. The greatest distinction, however, arose from the fact that the Germans received frequent supplementary allocations of food which were not issued to the Polish population, many articles of food being forbidden to the Poles altogether.

In the General Government area conditions were much worse as, in addition to the above regulations, separate shops for the Germans were set up. These

* Analysis of the German Food-Rationing System in Poland by Leon Dmochowski. Pp. 92. (London: Polish Ministry of Labour and Social Welfare, 1944.)

shops were officially supplied with food stocks for distribution; but there was no official system of allocation to the Polish shops, the population merely being notified in the newspapers of the days when food could be obtained for certain types of coupons. Furthermore, local food officials were given powers which enabled them to keep the population very much at their mercy, and there seems no doubt that in many cases official rations were theoretical rather than actual.

Even bread and potatoes were restricted, and the official rations must have represented very nearly the total amount of food that could be obtained. The only possibilities of supplementation (in the towns) seem to have been by allotment produce and by purchase in the 'black market'. The limited free space in the towns meant that not many people could derive benefit from the allotments scheme, and the 'black market' as a source of food was naturally limited to those with money or valuables to offer in exchange.

In the rural districts the situation would not be quite so bad; but the strict regulations enforced on the agricultural population must certainly have resulted in a shortage of food. Farmers had to supply a definite quantity of foodstuffs per unit area to the village co-operatives, and without a card certifying that this amount had been supplied were unable to obtain agricultural implements and other necessary requisites. Since the German authorities were pressed to obtain as much food as possible for export to the Reich, we can be quite sure that these quotas would be set as high as the local officials dared place them. Cattle, sheep and poultry were all registered and kept under strict control.

Despite German efforts, food production declined. But exports to Germany continued, over and above the compulsory feeding of the military and civilian army of occupation. This was chiefly possible because of the plan that the Aryan Polish population should be allotted only half the German ration and the Jews only one-quarter. The number of ration cards issued in the Warsaw ghetto show another way in which food 'surpluses' became available. In 1941, 433,000 cards were issued; in 1942 only 40,000 seemed necessary.

The Poles did what they could to help each other, and the book gives details of the work attempted by the Social Welfare Committee. It was calculated that at least 1,188,000 people required immediate help in 1942. Help was only sufficient to aid 827,000 at the beginning and this number dropped to 199,000 at the end of the year. The food available for distribution by the Committee would yield about 274 calories per head per day (if distributed among 200,000 persons).

Prior to 1941 the Social Welfare Committee was permitted to receive aid from abroad, and children were given first call on the food so obtained. After the attack on the Soviet Union this aid ceased, and in 1942 the German authorities closed down the distributing centres, and the food stores which had been collected for relief work were taken for feeding adults engaged in war industry.

The following table shows the calorie and total protein values of the official food rations in 1942 in Wartheland (in the General Government area the values were lower, and for Jews in any area very much lower). In 1943, these values fell lower still and in 1944 the heavy fighting which took place over a large area of the country must have made the food situation even worse.

Age group	Calories	Total protein
Children up to 3 yr.	1267	41 gm.
3–10 yr.	1455	44 ,,
over 10 yr.	1642	46 ,,
Adults	1598	42 ,,
Pregnant and nursing mothers	1598	42 ,,

Full details are given of the bases of the assessments, and calculations for other nutrients and for various groups of the population are included. The book also contains a section devoted to proposed measures for post-war relief.

In the introduction it is stated that "the application of a food policy based on human needs . . . will contribute to the social welfare of the people, to the rise of the standard of living, improvement of national health and the development of agricultural and economic prosperity". Let us hope that Poland may be fortunate enough in the future always to have a Government willing to implement such a policy.

M. W. GRANT

A STUDY OF THE DIPTEROCARPACEÆ

DURING the advance down Malaya of the Japanese army Colin F. Symington, forest botanist in the Federated Malay States, was under arms on the west coast of the Peninsula; and when the Japanese reached Singapore he managed to get away to the Dutch Indies and so to Australia. He was then posted to Nigeria where, to the great loss of forest botany, he died in 1943. He had left in Kuala Lumpur in final proof "A Forester's Manual to the Dipterocarpaceæ", together with material for more than a hundred plates from photographs prepared for its illustration. The Japanese discovered the text and caused it to be printed and issued as No. 16 of the *Malayan Forest Records*, using for proof-reading the services of two capable Government officers who were in their hands. Nothing was done with the materials for the plates; but it is understood that these will be published separately as soon as possible.

The "Manual" (pp. xliii + 244, with 114 text-figures) must be regarded as a progress report. It gives a forestry account of all the species (159) which the writer recognized. But it is incomplete without its plates; and no full review can be profitable until they have appeared. Meanwhile it will serve foresters who have local knowledge enough to be able to use it. Indeed it is for them that it has been prepared. The keys are field-keys, for use with sterile material. Also they make use of the ecological conditions under which the species grow, with the purpose that they should aid the inquirer in the forest. Leaves, stipules and fruits are shown in the text-figures; but the facies has been reserved for the plates.

One leading purpose the author has had—to stabilize the vernacular names so that work done through subordinates speaking Malay may be fully co-ordinated. This achieved, the greatest good will accrue to forest administration from the printing of the book.

A botanist will find in it valuable phytogeographic data and an ingenious diagram of altitudinal distribution.

Symington expresses a belief that relative stability has been reached in the nomenclature and grouping of the species. But has it? He has made so many changes in both that it would be premature to think that some of them will not be challenged.

I. H. BURKILL

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Saturday, May 18—Sunday, May 19

ASSOCIATION OF SCIENTIFIC WORKERS, CAMBRIDGE BRANCH (in the Old Combination Room, Trinity College, Cambridge).—Conference on the "Broadcasting of Science".

Saturday, May 18

At 2.30 p.m.—First Session.

Sunday, May 19

At 10.30 a.m.—Second Session.

Monday, May 20

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.15 p.m.—Mr. S. W. Amos: "Sound Reproduction".

Tuesday, May 21

ROYAL PHOTOGRAPHIC SOCIETY, SCIENTIFIC AND TECHNICAL GROUP (at 16 Princes Gate, London, S.W.7), at 6 p.m.—Mr. L. V. Chilton: "How it Works in Photography", 4: "Tone Reproduction".

Wednesday, May 22

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. Chen Yuan: "Chinese Culture in War-Time".

INSTITUTE OF METALS (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 6 p.m.—Prof. N. F. Mott, F.R.S.: "Atomic Physics and Mechanical Strength of Metals" (Thirty-fourth Annual May Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS, LONDON STUDENTS' SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Annual General Meeting.

Thursday, May 23

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. H. Bohr: "Almost Periodic Movements".

PHYSICAL SOCIETY, COLOUR GROUP (at the Royal Photographic Society, 16 Princes Gate, London, S.W.7), at 3.30 p.m.—Dr. L. C. Thomson and Dr. W. D. Wright: "The Colour Sensitivity of the Retina within the Central Fovea of Man".

MINERALOGICAL SOCIETY (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. J. M. Fleming: "Mica as a Munition of War" (with contributions by Prof. W. Q. Kennedy, Mr. W. C. C. Rose and Dr. E. R. Varley).

Friday, May 24

INSTITUTION OF MECHANICAL ENGINEERS, in association with the APPLIED MECHANICS GROUP (at Storey's Gate, St. James's Park, London, S.W.1), at 10.30 a.m. and 2.30 p.m.—Conference on "Machinability".

KING'S COLLEGE, Strand, London, W.C.2, at 5 p.m.—Prof. D. van Dantzig: "Affirmative and Intuitionistic Mathematics", 1 (Lectures 2 and 3 will be given on May 28 and June 3).*

INSTITUTION OF ELECTRICAL ENGINEERS, MEASUREMENTS SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Sir Harold Spencer Jones, F.R.S.: "The Measurement of Time".

Thursday, May 23—Saturday, May 25

SOCIETY OF DYERS AND COLOURISTS (at the University, Leeds), at 10.30 a.m. each day.—Symposium on "Fibrous Proteins, Natural and Synthetic".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MINING—The Acting Principal, Huddersfield Technical College, Huddersfield (May 25).

LECTURER IN PHYSICS AND CHEMISTRY, and a LECTURER IN MECHANICAL ENGINEERING, at the Southend Municipal College—The Chief Education Officer, Education Office, Warrior Square, Southend-on-Sea (May 25).

DIRECTOR OF VETERINARY SERVICES, Government of Bombay—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 25).

ASSISTANT LECTURER IN THE DEPARTMENT OF PHYSICS—The Registrar, University College, Singleton Park, Swansea (May 31).

ASSISTANT LECTURER (woman) IN CHEMISTRY and TUTOR FOR WOMEN, in the Bradford Technical College—The Director of Education, Town Hall, Bradford (May 31).

PHYSICIST to the Radiotherapy Department—The Secretary, Glasgow Royal Infirmary, 135 Buchanan Street, Glasgow, C.1 (May 31).

LECTURERS (2) IN NATURAL PHILOSOPHY—The Secretary, The University, St. Andrews (May 31).

PURDIE LECTURER (with specialization in either Organic or Physical Chemistry), a LECTURER (with specialization in either Organic or Physical Chemistry), and a LECTURER (with interests in either Organic or Physical Chemistry), in the Chemistry Department of the United College of St. Salvator and St. Leonard—The Secretary, The University, St. Andrews (May 31).

ASSISTANT OR LECTURER IN GEOLOGY—The Secretary of University Court, The University, Glasgow (June 1).

LECTURER (Grade II) IN THE DEPARTMENT OF BIOCHEMISTRY—The Registrar, The University, Liverpool (June 1).

TEACHER OF PHYSICS AND ELECTRONICS, and a TEACHER OF MATHEMATICS with subsidiary Radio Technology, at the Norwood Technical Institute—The Education Officer (T.1), County Hall, London, S.E.1 (June 8).

ASSISTANT LECTURER IN ZOOLOGY—The Registrar, The University, Reading (June 10).

LECTURER IN CHEMISTRY, a LECTURER IN PHYSICS, a LECTURER IN MATHEMATICS, and a LECTURER IN BIOLOGY, at the University of Hong Kong—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.2 (June 10).

OFFICER-IN-CHARGE, Masonry Investigations, Building Materials Research, Melbourne—The Secretary, Australian Scientific Research Liaison Office, Australia House, Strand, London, W.C.2 (June 15).

READERSHIP IN APPLIED MATHEMATICS tenable at Birkbeck College—The Academic Registrar, University of London, Senate House, London, W.C.1 (June 18).

PROFESSOR OF MATHEMATICS, and a PROFESSOR OF PHYSICS, in the University of the Witwatersrand, Johannesburg—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (June 30).

UNIVERSITY ASSISTANT IN THE DEPARTMENT OF ASTRONOMY—The Secretary, The University, St. Andrews.

JUNIOR RESEARCH PHYSICIST, a JUNIOR RESEARCH CHEMIST, and a HEAD of a projected new department in Laboratories in south-east London, comprising Electrical Instruments and Electronics Sections—The Secretary, British Scientific Instrument Research Association, 26 Russell Square, London, W.C.2.

INVESTIGATORS (2, with good degree in Metallurgy or its equivalent) on the research staff—The Secretary, British Non-Ferrous Metals Research Association, Euston Street, London, N.W.1.

LECTURER IN PHYSICS up to B.Sc. standard—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

We Demand the Freedom of the Hills. Pp. 4. (London: Ramblers' Association, 1945.) [3110

The New Age of Atomics. (New Age Series, No. 1.) Pp. 16. (London: Social Science Association, 1945.) 6d. [3110

Ministry of Education. Pamphlet No. 3: Youth's Opportunity—Further Education in County Colleges. Pp. 54. (London: H.M. Stationery Office, 1945.) 1s. net. [3110

Imperial Forestry Bureau. Technical Communication No. 4: The Application of Meteorology to Forest Fire Protection. By J. G. Wright and H. W. Beall. Pp. 24. (Oxford: Imperial Forestry Bureau, 1945.) 2s. 6d. [611

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Series H, No. 16: Varieties and Strains of Red and White Clover—British and Foreign. By Watkins Williams. Pp. 26+6 plates. (Aberystwyth: Welsh Plant Breeding Station, 1945.) 2s. 6d. [611

Medical Research Council. War Memorandum No. 10: Food Yeast, a Survey of its Nutritive Value. By the Accessory Food Factors Committee. Pp. 16. (London: H.M. Stationery Office, 1945.) 3d. net. [611

Other Countries

The Exodus from Travancore to Malabar Jungles. Surveys by Shri K. G. Sivaswamy, Lt.-Col. T. S. Shastry, Dr. T. D. Nair, Dr. T. S. Nair, Dr. P. A. Narayanan, Dr. C. V. Narayana Aiyar and Dr. Miss Atzorri. Pp. 44. (Coimbatore: Servindia Kerala Relief Centre, 1945.) 1 rupee. [1810

Food Famine and Nutritional Diseases in Travancore (1943–1944). Surveys by Sri K. G. Sivaswamy, K. K. Chandy and Lt.-Col. T. S. Shastry, Dr. M. E. Naidu, Dr. T. V. S. Shastry and 7 other Doctors. Pp. xii+264. (Coimbatore: Servindia Kerala Relief Centre, 1945.) 5 rupees. [1810

Report on the Scientific Results of the *Michael Sars* North Atlantic Deep-Sea Expedition, 1910. Vol. 4, Part 2, No. 1: Pediculati from the *Michael Sars* North Atlantic Deep-Sea Expedition, 1910. By Einar Koefoed. Pp. 18+3 plates. (Bergen: Bergen Museum, 1944.) [1810

Illinois Monographs in the Medical Sciences. Vol. 5, No. 3: The Cortex of Galago, its relation to the Pattern of the Primate Cortex. By Prof. Gerhardt von Bonin. Pp. 55. (Urbana, Ill.: University of Illinois Press, 1945.) [1810

Kungl. Svenska Vetenskapsakademiens Handlingar. Serien 3, Band 19, No. 1: Om Nordens; Främst Baltikums, Senkvartära Utveckling och Stenåldersbebyggelse (On the Late-Quaternary Development and the Stone Age Settlement of North Europe, primarily the Baltic.) Av Henr. Munthe. Pp. 242+16 plates. Serien 3, Band 19, No. 2: The Tertiary Fossil Conifers of South Chile and their Phyto-Geographical Significance, with a Review of the Fossil Conifers of Southern Lands. By Rudolf Florin. Pp. 107+6 plates. Serien 3, Band 22, No. 1: On the Heads of certain Anthrodires, 2: On the Cranium and Cervical Joint of the Dolichothoraci (Acanthaspida). By Erik A:son Stensiö. Pp. 70. Serien 3, Band 22, No. 2: Studies of Reflection Nebulæ. By Carl Schalén. Pp. 64. (Stockholm: Almquist and Wiksells Boktryckeri A.-B., 1940–1945.) [1810

U.S. Department of Agriculture. Circular No. 664: The Mountain Pine Beetle, an Important Enemy of Western Pines. By James C. Evenden, W. D. Bedard and G. R. Struble. Pp. 25. 5 cents. Picture Sheet No. 14: European Corn Borer. Pp. 2. 5 cents. (Washington, D.C.: Government Printing Office, 1943–1945.) [1810